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POLLUTION OF THE INTERSTATE WATERS OF THE UPPER MISSISSIPPI RIVER. CONFERENCE HELD AT ST. PAUL, MINNESOTA ON FEBRUARY 8, 1964. VOLUME III

Public Health Service
Washington, D.C.

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CONFERENCE

in the matter of

Pollution of the Interstate Waters of the UPPER MISSISSIPPI RIVER

VOLUME III

St. Paul, Minnesota
February 8, 1964

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Washington, D.C.

VOLUME III

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Dr. M. M. Hargraves (Con't)

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EXHIBIT XIII

STATE OF MINNESOTA

WATER POLLUTION CONTROL COMMISSION

CLASSIFICATION AND STANDARDS FOR THE MISSISSIPPI RIVER AND TRIBUTARIES FROM THE RUM RIVER TO THE UPPER LOCK AND DAM AT ST. ANTHONY FALLS

The classification for use and the pollution standards as hereinafter set forth are hereby adopted and established for that portion of the Mississippi River from but not including the mouth of the Rum River to the upper lock and dam at St. Anthony Falls, approximately at the northeastward extension of Fifth Avenue South in the City of Minneapolis, and streams tributary thereto.

Section 1. Classification for Use.

(a) The primary use of the waters requiring maintenance of water quality in accordance with the standards hereinafter prescribed is as a source of public water supply for drinking, food processing, and related purposes.

(b) Other uses for which waters of such quality are suitable are industrial processing and cooling, navigation, pleasure boating, fishing, bathing, swimming, and other recreational uses, subject to such restrictions on any such uses which involve close, frequent, or prolonged contact with the water as may be necessary for protection of public health.

(c) Other beneficial uses for which water of lower quality may be suitable may be exercised in the waters, provided the effects do not actually or potentially conflict with the uses specified in paragraphs (a) and (b).

Section 2. Related Conditions

The waters should meet the recommended U. S. Public Health Service raw water requirements for Group IV, as defined in Public Health Bulletin No. 296, Manual of Recommended Water Sanitation Practice, 1946, so that after Class IV treatment as specified in said manual the water will meet the requirements for drinking water as specified in U. S. Public Health Service Drinking Water Standards, 1962. Waters having the quality aforesaid will be suitable for maintenance of game fish of species commonly inhabiting waters of the vicinity under natural conditions.

Section 3. Standards

(a) No raw sewage, and no industrial waste or other wastes, treated or untreated, containing viable pathogenic organisms or any substances which may cause disease, endanger the public health, or otherwise impair the quality of the receiving waters for public water supply shall be discharged into the waters.

(b) No treated sewage effluent shall be discharged into the waters from any source originating after the taking effect hereof, including, without limitation, discharges from watercraft.

(c) No treated sewage effluent, industrial waste, or other wastes shall be discharged into the waters so as to cause any nuisance conditions, including, without limitation, the presence of substantial amounts of floating solids, scum, oil slicks, suspended solids, material discoloration, obnoxious odors, visible gassing, sludge deposits, substantial fungus growths, or other offensive effects.

(d) No treated sewage effluent, industrial waste, or other wastes shall be discharged into the waters so as to cause any material increase in taste, odor, color, or turbidity above natural levels, or otherwise to impair the quality of the water so as to render it objectionable or unsuitable as a source of water supply.

(e) The discharge of oxygen-demanding treated sewage effluent, industrial waste, or other wastes shall be restricted so that after reasonable opportunity for mixing and dilution thereof with the receiving waters the dissolved oxygen content of such waters will be maintained at not less than 5 milligrams per liter, based on the monthly average flow which is exceeded by 90 per cent of the monthly average flows of record for the month of August or February, whichever is lower, and so that a level of not less than 4 milligrams per liter will be maintained under any instantaneous low flow conditions.

(f) The discharge of industrial waste or other wastes shall be controlled so that the heat content of such discharges, after reasonable opportunity for mixing and dilution thereof with the receiving waters, does not raise the temperature of such waters above 93° F at any point, based on the critical month of August and the monthly average flow specified in paragraph (e).

(g) The discharge of treated sewage effluent, industrial waste, or other wastes shall be restricted so that at any water supply intake the maximum limits for chemicals in the waters shall be such that after Class IV treatment has been provided as specified in Section 2 (Public Health Bulletin No. 296), the concentrations recommended in the U. S. Public Health Service Drinking Water Standards, 1962, will not be exceeded in the treated water. Such discharges shall also be restricted so that after reasonable opportunity for mixing and dilution of the discharge with the receiving waters, on the basis of the monthly average flow specified in paragraph (e), the concentrations of the substances specified below will not be exceeded in the waters.

Ammonia	2.0 milligrams per liter (as Nitrogen)
Chromium	1.0 milligrams per liter (as Chromium)
Copper	0.2 milligrams per liter (as Copper)
Cyanide	0.02 milligrams per liter (as Cyanide ion)
Oil	Not to exceed a trace
pH range	6.5 - 9.0
Radioactive materials	Not to exceed the lowest concentrations permitted to be discharged to an uncontrolled environment as prescribed by

the appropriate Federal authority
or by the State Board of Health.

Means for expediting mixing and dispersion of such treated sewage effluent, industrial waste, or other wastes in the receiving waters shall be provided so far as practicable whenever deemed necessary by the Commission to maintain the quality of the receiving waters in accordance with applicable standards.

(h) No treated sewage effluent, industrial waste, or other wastes shall be discharged into the waters in such quantity or in such manner alone or in combination with other substances as to cause pollution thereof as defined by law.

(i) In any case where, upon application of the responsible person or persons, the Commission finds after a hearing thereon that by reason of exceptional circumstances the strict enforcement of a provision of these standards would cause undue hardship and would be unreasonable, that disposal of the sewage, industrial waste, or other wastes involved is necessary for public health, safety, and welfare, and that no means for such disposal in strict conformity with the standards is reasonably available, the Commission, in its discretion, may permit a variance therefrom upon such conditions as it may prescribe for prevention, control, or abatement of pollution and in harmony with the general purpose and intent of the standards.

Adopted March 28, 1963

* * *

EXHIBIT XIV

STATE OF MINNESOTA

WATER POLLUTION CONTROL COMMISSION

CLASSIFICATION AND STANDARDS FOR THE MISSISSIPPI RIVER AND TRIBUTARIES FROM THE UPPER LOCK AND DAM AT ST. ANTHONY FALLS TO THE OUTFALL OF THE MINNEAPOLIS-ST. PAUL SANITARY DISTRICT SEWAGE TREATMENT PLANT

The classification for use and the pollution standards as hereinafter set forth are hereby adopted and established for that portion of the Mississippi River from the upper lock and dam at St. Anthony Falls, approximately at the northeastward extension of Fifth Avenue South in the City of Minneapolis, to immediately above the outfall of the Minneapolis-St. Paul Sanitary District sewage treatment plant in the City of St. Paul, approximately at the eastward extension of Baker Street East in said city, and streams tributary thereto except the Minnesota River.

Section 1. Classification for Use.

(a) The uses of the waters requiring maintenance of water quality in accordance with the standards hereinafter prescribed are pleasure boating, fishing, and other recreational uses, subject to such restriction on any such uses which involve close, frequent, or prolonged contact with the water as may be necessary for protection of public health.

(b) The waters may be used for navigation, general industrial purposes, and other beneficial uses for which water of lower quality may be suitable, provided the effects do not actually or potentially conflict with the uses specified in paragraph (a).

Section 2. Related Conditions

The waters are suitable for the aforesaid uses and for maintenance of game fish of species commonly inhabiting waters of the vicinity under natural conditions, but not as a source of drinking water or special quality industrial process water, or for bathing or swimming, subject to such restrictions on any such uses which involve close, frequent, or prolonged contact with the water as may be necessary for protection of public health.

Section 3. Standards

(a) No major quantities of sewage, industrial waste, or other wastes, treated or untreated, shall be discharged into the waters. No treated sewage, industrial waste, or other wastes containing viable pathogenic organisms shall be discharged into the waters without effective disinfection during the summer months, except under emergency conditions. Effective disinfection of any discharges, including combined flows of sewage and storm water, may be required to protect the aforesaid uses of the waters.

(b) No sewage, industrial waste, or other wastes shall be discharged into the waters so as to cause any nuisance conditions, including, without limitation, the presence of substantial amounts of floating solids, scum, oil slicks, suspended solids, material discoloration, obnoxious odors, visible gassing, sludge deposits, substantial fungus growths, or other offensive effects.

(c) The discharge of oxygen-demanding sewage, industrial waste, or other wastes shall be restricted so that after reasonable opportunity for mixing and dilution thereof with the receiving waters the dissolved oxygen content of such waters will be maintained at not less than 4 milligrams per liter, based on the monthly average flow which is exceeded by 90 per cent of the monthly flows of record for the month of August or February, whichever is lower, and so that a level of not less than 3 milligrams per liter will be maintained under the minimum daily flow which is exceeded by 98 per cent of the minimum daily flows of record for the month of August or February, whichever is lower.

(d) The discharge of industrial waste or other wastes shall be controlled so that the heat content of such discharges, after reasonable opportunity for mixing and dilution thereof with the receiving waters, does not raise the temperature of such waters above 93° F, based on the critical month of August and the monthly average flow specified in paragraph (c).

(e) The discharge of sewage, industrial wastes, or other wastes shall be restricted so that, on the basis of the monthly average flow specified in paragraph (c), the limits hereinafter specified will not be exceeded in the waters after reasonable opportunity for mixing and dilution:

Ammonia	2.0 milligrams per liter (as Nitrogen)
Chromium	1.0 milligrams per liter (as Chromium)
Copper	0.2 milligrams per liter (as Copper)
Cyanide	0.02 milligrams per liter (as Cyanide ion)
Oil	10 milligrams per liter
pH range	6.0 - 9.0
Phenolic materials	0.01 milligrams per liter (as Phenol)
Radioactive materials	Not to exceed the lowest concentrations permitted to be discharged to an uncontrolled environment as prescribed by the appropriate Federal authority or by the State Board of Health

Means for expediting mixing and dispersion of such sewage, industrial waste, or other wastes in the receiving waters shall be provided so far as practicable whenever deemed necessary by the Commission to maintain the quality of the receiving waters in accordance with applicable standards.

(f) No sewage, industrial waste, or other wastes shall be discharged into the waters in such quantity or in such manner alone or in combination with other substances as to cause pollution thereof as defined by law.

(g) In any case where, upon application of the responsible person or persons, the Commission finds after a hearing thereon that by reason of exceptional circumstances the strict enforcement of a provision of these standards would cause undue hardship and would be unreasonable, that disposal of the sewage, industrial waste, or other wastes involved is necessary for public health, safety, and welfare, and that no means for such disposal in strict conformity with the standards is reasonably available, the Commission, in its discretion, may permit a variance therefrom upon such conditions as it may prescribe for prevention, control, or abatement of pollution and in harmony with the general purpose and intent of the standards.

Adopted March 28, 1963

* * *

EXHIBIT XV

STATE OF MINNESOTA

WATER POLLUTION CONTROL COMMISSION

CLASSIFICATION AND STANDARDS FOR THE MISSISSIPPI RIVER AND TRIBUTARIES FROM THE OUTFALL OF THE MINNEAPOLIS-ST. PAUL SANITARY DISTRICT SEWAGE TREATMENT PLANT TO LOCK AND DAM NO. 2 NEAR HASTINGS

The classification for use and the pollution standards as hereinafter set forth are hereby adopted and established for that portion of the Mississippi River from immediately above the outfall of the Minneapolis-St. Paul Sanitary District sewage treatment plant in the City of St. Paul, approximately at the eastward extension of Baker Street East in said city to the U. S. lock and dam No. 2 above Hastings.

Section 1. Classification for Use

The uses of the waters requiring maintenance of water quality in accordance with the standards hereinafter prescribed are for industrial processes, general cooling water, stock and wild life watering, restricted irrigation, disposal of treated sewage and waste effluents, fish survival, esthetic enjoyment of river scenery, and passage of watercraft in connection with navigation and pleasure boating in such manner as to avoid close, frequent, or prolonged contact with the water.

Section 2. Related Conditions

The waters are suitable for the aforesaid uses and for survival or passage of game fish of species commonly inhabiting waters of the vicinity under natural conditions, and for disposal of treated sewage and industrial waste effluents for which no other means of disposal is available. Treatment of the waters may be necessary for some industrial uses.

Section 3. Standards

(a) No major quantities of untreated sewage, industrial waste, or other wastes shall be discharged into the waters. No treated sewage, industrial waste, or other wastes containing viable pathogenic organisms shall be discharged into the waters without effective disinfection during the summer months, except under emergency conditions. Effective disinfection of any discharges, including combined flows of sewage and storm water, may be required to protect the aforesaid uses of the waters.

(b) No sewage, industrial waste, or other wastes shall be discharged into the waters so as to cause any nuisance conditions, including, without limitation, the presence of substantial amounts of floating solids, scum, oil slicks, suspended solids, material discoloration, obnoxious odors, visible gassing, sludge deposits, substantial fungus growths, or other offensive effects.

(c) The discharge of oxygen-demanding sewage, industrial waste, or other wastes shall be restricted so that after reasonable opportunity for mixing and dilution thereof with the receiving waters the dissolved oxygen content of such waters will be maintained at not less than 2 milligrams per liter, based on the monthly average flow which is exceeded by 90 per cent of the monthly average flows of record for the month of August or February, whichever is lower, and so that a level of not less than 1 milligram per liter will be maintained under the minimum daily flow which is exceeded by 95 per cent of the minimum daily flows of record for the month of August or February whichever is lower. In addition to the aforesaid requirements, the highest levels of dissolved oxygen which are attainable by continuous operation of all the units of the treatment works discharging into this reach of the river at their maximum capability consistent with practical limitations of such works shall be maintained in the waters, except for emergencies, in order to improve conditions for fish and for other uses of the waters.

(d) The discharge of industrial waste or other wastes shall be controlled so that the heat content of such discharges, after reasonable opportunity for mixing and dilution thereof with the receiving waters, does not raise the temperature of such waters above 93° F based on the critical month of August and the monthly average flow specified in paragraph (c). Further reduction in heat discharges may be required if necessary to avoid substantial interference with or adverse effects upon other uses.

(c) The discharge of sewage, industrial wastes, or other wastes shall be restricted so that, on the basis of the monthly average flow specified in paragraph (c), the limits hereinafter specified will not be exceeded in the waters after reasonable opportunity for mixing and dilution:

Ammonia	2.0 milligrams per liter (as Nitrogen)
Chromium	1.0 milligrams per liter (as Chromium)
Copper	0.2 milligrams per liter (as Copper)
Cyanide	0.02 milligrams per liter (as Cyanide ion)
Fluoride	2.0 milligrams per liter (as Fluoride ion)
Oil	10 milligrams per liter
pH range	6.0 - 9.5
Phenolic materials	0.1 milligrams per liter (as Phenol)
Radioactive materials	Not to exceed the lowest concentrations permitted to be discharged to an uncontrolled environment as prescribed by the appropriate Federal authority or by the State Board of Health.

Means for expediting mixing and disperson of such treated sewage effluent, industrial waste, or other wastes in the receiving waters shall be provided so far as practicable whenever deemed necessary by the Commission to maintain the quality of the receiving waters in accordance with applicable standards.

(f) No sewage, industrial waste, or other wastes shall be discharged into the waters in such quantity or in such manner alone or in combination with other substances as to cause pollution thereof as defined by law.

(g) In any case where, upon application of the responsible person or persons, the Commission finds after a hearing thereon that by reason of exceptional circumstances the strict enforcement of a provision of these standards would cause undue hardship and would be unreasonable, that disposal of the sewage, industrial waste, or other wastes involved is necessary for public health, safety, and welfare, and that no means for such disposal in strict conformity with the standards is reasonably available, the Commission, in its discretion, may permit a variance therefrom upon such conditions as it may prescribe for prevention, control, or abatement of pollution and in harmony with the general purpose and intent of the standards.

Adopted March 28, 1963.

* * *

EXHIBIT XVI

Report on Investigation
# of the Mississippi River
From the Mouth of the Rum River
To the Mouth of the St. Croix River

July and August, 1960
and
August and September, 1961

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MINNESOTA DEPARTMENT OF HEALTH
Division of Environmental Sanitation
Section of Water Pollution Control
for the
Minnesota Water Pollution Control Commission

Report on Investigation of the Mississippi River from the Mouth of the Rum River to the Mouth of the St. Croix River

July and August, 1960, and August and September, 1961*

(*Includes information as of May, 1962.)

INTRODUCTION

The 1961 investigations of the river were made to obtain information for the Legislature and others concerned and to provide a basis for possible classification and adoption of standards for the Mississippi River in this area by the Water Pollution Control Commission. The general area under consideration is shown in Figure I.

Scope of the Investigation

The major part of the field investigation was confined to the Metropolitan Area from the Coon Rapids dam to immediately below the junction of the St. Croix River and the Mississippi River. The field investigation from the mouth of the Rum River in Anoka to the Coon Rapids dam was completed in August, 1960. The field investigations consisted of physical observations and collection of water samples at representative stations for bacteriological and chemical analysis. Bottom mud samples were also collected for determination of percent volatile material and examination for bottom fauna. An inspection of all the major storm, sanitary, and combined sewers discharging to the Mississippi River in the Twin Cities was made with personnel of the MSSD (Minneapolis-St. Paul Sanitary District). A copy of the sewer inspection report by the MSSD for this tour is attached as Appendix E.

The sampling stations are shown in Figures II, III, and IV, and described in Tables 1 and 2.

Personnel

C. E. Kiester and L. E. Richie, Assistant Public Health Engineer and Geologist, respectively, were in charge of the field party. R. D. Miller, W. F. Hodgins and T. R. Shelton, Assistant Public Health Engineer and Engineering Aides, respectively, participated in the field survey, together with several temporary employees. The survey was organized and conducted under the general direction of L. H. Smith, Chief of the Section of Water Pollution Control and Executive Engineer of the Water Pollution Control Commission, and C. A. Johannes, Public Health Engineer. The basic report was prepared by C. E. Kiester.

Physical, chemical, and bacteriological examinations of the samples were performed in the laboratory of the Division of Environmental Sanitation under the direction of R. E. Frazier, Chief of the Section of Engineering Laboratories.

Acknowledgements

Maurice L. Robins, Chief Chemist and Sanitary Engineer, S. M. Schwartzfield, Chemist, and P. F. Farinacci, Chemist Aide, all of the MSSD staff rendered valuable assistance during the survey.

BACKGROUND INFORMATION

Previous General Surveys

In 1928 a comprehensive survey(3) was made of the Mississippi River from the Camden bridge in Minneapolis to below LaCrosse, Wisconsin, by the Minnesota Department of Health in collaboration with the Minnesota Commissioner of Game and Fish and the Wisconsin Department of Health. The main conclusion drawn from this survey on the condition of the river in the Metropolitan Area was that "a condition of public nuisance exists, except during periods of relatively high water, in the section of the river from the head of the pool above the Twin City Lock and Dam in

Minneapolis to the influx of the St. Croix River at Prescott" This condition was evidenced by odors, floating and suspended material, sludge deposits and by the ebullition of gases. It was recommended by the participating agencies that "the pollution of the river should be restricted to such an extent that the public health hazard will be reduced to a minimum, that the health of live stock will not be materially endangered, that the present public nuisance will be eliminated, and that fish life in the river, at least below the mouth of the St. Croix, will not be jeopardized."

In 1933 another pollution survey(4) of the Mississippi River from the Minneapolis water treatment plant in Fridley to the Hastings dam was made by this Department. It was found during this survey that "the polluted condition of the Mississippi River in the Metropolitan Area had not improved since the investigation of 1928; in fact, the pollution was more pronounced at this time than it had been in the past". During the period from June, 1929, through the summer of 1933, the Metropolitan Drainage Commission had also collected samples, at intervals of two weeks or less, from the river at sampling points extending from above Minneapolis to the outlet of Lake Pepin.

The Minneapolis-St. Paul Sanitary District sewage treatment plant was constructed in 1938 and the South St. Paul waste treatment plant was constructed in 1940.

One of the operational responsibilities imposed upon the MSSD by this Department was the collection of data on the condition of the river. Since that time the MSSD has done sampling of the river throughout the Metropolitan Area and below, and has routinely analyzed the samples for bacterial numbers and chemical content. The MSSD now samples at a total of 24 stations, from the Minneapolis water purification plant in Fridley to the outlet of Lake Pepin above Read's Landing. Samples are normally collected twice a month at stations above the MSSD plant, once or twice a week at stations on the river from the MSSD plant to Red Wing, and approximately twice a month at stations on the lower river from Red Wing through Lake Pepin. Analyses are made in the laboratory of the MSSD plant.

From December 17, 1951, to January 17, 1952, a survey(5) of the Mississippi River from the Minneapolis water purification plant to the Ford dam was made by this Department. Shortly before and during this period, raw sewage was discharged to the river from Minneapolis sewers. The purpose of this discharge of raw sewage was to allow heat from the warm sewage (normally about 59° F) to melt ice which was causing congestion in the river. It was found during this survey that the coliform, 5-day BOD, suspended solids, and turbidities were higher in all samples taken at the Gage, Lock and Dam No. 1 (Ford Dam) than that which was normally expected using median values for 1950 and 1951 from the Minneapolis-St. Paul Sanitar District's records as a criterion.

In November of 1956, an investigation was made of Upper and Lower Spring Lake to determine the suitability for discharge of industrial wastes from St. Paul Ammonia Products, Inc. The results of this survey showed that wastes from the plant should go directly into the current of the Mississippi River and not into Spring Lake as originally proposed.

In January of 1956, a survey was made of the Mississippi River from the Fridley area to the Hastings dam in cooperation with the Minnesota Department of Conservation. The primary purpose of this investigation was to determine the cause of tainting of fish, the distribution of tainted fish, and main sources of the causative agents. The results of the survey were not conclusive.

In 1958, in conjunction with an investigation of waste disposal at St. Paul Ammonia Products, Inc., Liquid Carbonic Division, General Dynamics Corporation, and the Minnesota Mining and Manufacturing Company, Inc., Chemolite Plant, a survey of the Mississippi River in the Pine area was made by this Department(6,7). The survey showed that the general condition of the river in this area w relatively unsatisfactory, although the dissolved oxygen

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concentrations were higher than those found during the 1961 survey. At a number of locations, the banks near the waterline were covered with black septic sludge. The chemical analyses of the river samples showed a slight increase in the manganese and ammonia content of the river below the ammonia plant waste outfall.

In 1958, a survey(8) was made by this Department of the Mississippi River from Elk River to Hastings. This survey consisted mainly of the collection of samples for radioactivity analysis in order to determine background conditions.

A report(2) entitled "Pollution and Recovery Characteristics of the Mississippi River" has recently been completed and published. The project was sponsored by the MSSD following a public hearing on the condition of the river held by the Water Pollution Control Commission in June, 1956. The report was prepared by the Sanitary Engineering Division, Department of Civil Engineering, Institute of Technology, University of Minnesota, under the direction of Professor George J. Schroepfer, and covers river characteristics, deoxygenation, reaeration, river capacity investigations, degree of treatment requirements, and treatment supplementation.

In the past few years a number of fish kills in the area from St. Paul Park to the Hastings dam, mainly in the vicinity of Spring Lake, have been reported to this Department. The number and severity of these kills appear to be increasing each year. In September, 1961, a fish kill in the vicinity of Spring Lake was investigated by a member of this Department and a biologist of the staff of the Department of Conservation. The fish kill was generally confirmed.

Water Quality Sampling Program

Water samples for chemical and bacteriological analysis have been collected from the Mississippi River since 1953 by this Department as part of a statewide basic water quality monitoring program. On this part of the Mississippi River, samples have been collected at Anoka, the Minneapolis water purification plant, the Coon Rapids dam, and the Hastings dam. The analytical data have been compiled in published volumes which are available upon request to the Department(9).

Existing Sources of Wastes

Listed below are known specific sources of wastes with discharge directly to the Mississippi River. The list does not include intermittent discharges from storm or -pass sewers, which are discussed in a later section, or discharges which are not directly to the main stem of the river. A discussion of the tributaries is given in Appendix C.

Anoka (population 10,562)

The Anoka sewage treatment plant outfall is not in the area under consideration, but discharges to the Mississippi River immediately above the mouth of the Rum River. The plant consists of a grit chamber, primary settling tank, high-rate trickling filters, final settling tanks, chlorination contact tank and separate sludge digestion tanks. The sewage treatment plant is designed to treat sewage and industrial waste flowing at a rate of 1.44 mgd (million gallons per day), having a BOD (5-day biochemical oxygen demand) of 300 mg/1 (milligrams per liter) and to produce an effluent BOD of approximately 75 mg/1.

Northern States Power Company (Riverside Plant)

This steam electric generating plant is located at approximately Station M-5.9 in north Minneapolis. It had a capacity of about 300,000 kilowatts as of 1961. In February and August, 1960, the thermal additions to the river were about 11,000 million and 3,000 million BTU

(British Thermal Units) per day, respectively(2). February and August data are used since these are considered the two important months from the standpoint of river conditions. It is estimated that in the year 2000 the thermal additions will be approximately 13,000 million BTU per day in February and 10,000 million BTU per day in August. A substantial proposed expansion to this plant was announced recently by the Company.

Northern States Power Company (High Bridge Plant)

This steam generating power plant is located at approximately Station M-12.5 in St. Paul. It had a capacity of about 505,000 kilowatts as of 1961. In February and August, 1960, the thermal additions to the river were about 42,000 million and 31,000 million BTU per day, respectively(2). It is estimated that in the year 2000 the thermal additions will be approximately 26,000 million BTU per day in February and 27,000 million BTU per day in August.

Minneapolis-St. Paul Sanitary District (population served approximately 1,050,000)

The existing sewage treatment plant was designed to provide primary treatment of domestic sewage and a limited amount of industrial waste flowing at the rate of 134 mgd. The plant consists of the following units: mechanically cleaned bar screens, grit chambers, flocculating tanks, settling tanks, chemical feeders, chlorinators, sludge concentration tanks, vacuum filters, and incinerators. During periods of low river flow, sedimentation treatment may be augmented by flocculation and chemical treatment.

The average raw sewage flow to the plant in 1960 was 158.2 mgd., while the five year average from 1956 through 1960 was 147.8 mgd*. (*Flow and analytical data are from annual reports submitted by the Minneapolis-St. Paul Sanitary District to this Department.) The 1960 average BOD of the plant influent was 233 mg/1 and the 1960 average BOD of the plant effluent was 159 mg/1, or a reduction of approximately 32 per cent. The average BOD reduction through all the plant units from 1956 through 1960 was approximately 35 per cent. This leaves an approximate daily discharge of 210,000 lb. of BOD to the river, based on 1960 data. This amount will probably be somewhat larger in 1962 and increase in the future unless reduced by treatment, based on the yearly flow increase estimated from past records.

Preliminary studies on the sewage treatment needs of the Twin Cities Metropolitan Area have been completed. Plans and specifications for secondary treatment units on enlargement of the present plant to handle the flow for the area served are being prepared. Preliminary plans are to provide additional treatment facilities capable of producing an effluent of about 65 mg/1 of BOD. Approval of financing of the project was recently announced by the Board of Trustees.

South St. Paul (population 22,032)

The existing plant provides primary and secondary treatment for approximately 11 mgd of waste with an average BOD of approximately 1,190 mg/1. The plant was designed to treat packinghouse wastes and sewage flowing at the rate of 10.0 mgd with 800 mg/1 of BOD. An average BOD reduction of about 68 per cent is ordinarily achieved through the treatment units*. (*Based on annual reports submitted to this Department by the South St. Paul Sewage Commission.) On this basis, approximately 34,800 pounds of BOD is discharged to the river each day. The plant consists of the following units: grit chamber, grease flotation unit, flocculation tanks, primary settling tanks, standard-rate trickling filters, final settling tanks, chlorination contact tanks, and raw sludge lagoons.

Preliminary engineering studies have been completed and plans approved for improvements to the facilities, consisting of a proposed anaerobic effluent pond. This is expected by the consulting engineer to reduce the plant effluent BOD by 50 per cent for an overall final effluent concentration of about 200 mg/1.

King Packing Company

This is a meat processing plant located in the former Cudahy Packing Company plant in Newport. Recommendations have been made by this Department for adequate waste treatment facilities. This plant does not slaughter animals but processes frozen beef. Preliminary engineering studies are needed to determine the characteristics of the wastes.

Northwestern Refining Company, St. Paul Park

The waste treatment facilities consist of a cooling tower for oxidation of phenolics, stripping unit for removal of sulfides, an API oil separator, a small oil recovery lagoon, a larger oxidation lagoon, and a hay filter. The system was designed to treat oil refinery wastes flowing at the rate of about 3.3 mgd. The effluent of the large lagoon is discharged through hay filters directly to the Mississippi River. Spent caustic is segregated and disposed of separately. Reports on the effluent quality are submitted periodically to this Department by the Company.

St. Paul Park (population 3,267)

A secondary treatment plant was constructed in 1955. It was designed to treat sewage and waste at a rate of 0.200 mgd, with a 5-day BOD of 200 mg/1, and to produce an effluent of 40 mg/1. The plant consists of a duo-clarifier for primary and final sedimentation, high-rate trickling filter, chlorination contact tank, and separate sludge digestion tank. When the capacity of the plant is reached expansion of the existing plant will be necessary as indicated for the second stage of construction in the original design.

J. L. Shiely Company, Washington County

The Company has provided clarification basins for treatment of waste water from washing of gravel and sand.

St. Paul Ammonia Products, Inc., Dakota County

The waste treatment facilities consist of a basin for neutralization of spent process chemicals, pumps, an orifice meter and automatic flow-recording device, and a pH meter with automatic recorder. The system was designed for removal of floatable oil and the addition of chemicals as may be required to neutralize waste flowing at the rate of 0,650 mgd. The effluent is discharged, through a force main, to the Mississippi River near M-28.2. The Company submits a monthly report to this Department showing results of analysis of the waste for various constituents, such as nitrates, pH, oil, chromates, and ammonia. Domestic sewage is disposed of by means of septic tanks and soil absorption fields.

Liquid Carbonic, Division of General Dynamics Corporation, Dakota County

The wastes consist essentially of cooling water and a small amount of process chemicals used in the production of solid and liquid carbon dioxide from gas supplied by St. Paul Ammonia Products, Inc. The waste is pumped into the force main which also carries the waste from St. Paul Ammonia Products, Inc. Treatment consists of reaction with the St. Paul Ammonia Products, Inc., waste in the pipeline. Reports are submitted monthly with the report of St. Paul Ammonia Products, Inc.

Great Northern Oil Company, Dakota County

The waste treatment facilities consist of the following units: a chemical neutralization and stripping unit for treatment of spent chemicals, surge tank, caustic treating tower, an API oil separator, two storage lagoons, an emergency lagoon, a hay filter, biological filter for oxidation of phenols, and an aeroaccelator activated sludge unit. Domestic sewage is treated in septic tanks and soil absorption fields. The complete waste disposal system is designed to treat an average flow of about 2.88 mgd, including storm water.

The effluent of the final lagoon is pumped intermittently to the Mississippi River at approximately M+28.4. Reports on the effluent quality and flow are submitted periodically.

Northwest Cooperative Mills, Inc., Dakota County.

The waste treatment facilities for this phosphoric acid and ammonium phosphate plant consist of a storage lagoon, pumping station, and storm water collection system with detention pond and conductivity sensing system. The lagoon is designed for an average waste flow of 4.32 mgd and will be operated essentially as a closed system with the lagoon effluent being reused in the plant. Gypsum sludge will be stored in the lagoon. Area run-off is to be monitored, and if found to be of unsatisfactory quality, will be diverted to an emergency detention pond. Domestic sewage is treated in septic tanks and soil absorption fields.

Cottage Grove Township, Washington County

The sewage treatment plant serves one subdivision ([illegible] Estates) and is designed to provide primary and secondary treatment, by the activated sludge process, for sewage from a population of about 4,000, or a flow of 0.400 mgd with a BOD of about 200 mg/1. The units are considered capable of producing an effluent of approximately 20 mg/1 of BOD, and a high reduction in solids. The plant consists of a manually cleaned bar screen, primary settling tank, aeration tank, secondary settling tank, chlorinator, and chlorination contact tank, heated sludge digestion tank and sludge drying beds. The effluent is discharged to the Mississippi River. Provision is made for expansion of the plant to include additional subdivisions.

Minnesota Mining and Manufacturing Company, Chemolite Plant
Washington County

The waste disposal facilities include a short-term settling and skimming basin, an oxidation lagoon, and an aeration flume. Phenolic wastes have been segregated and are disposed of separately. Cooling water is segregated and discharged separately. Domestic sewage is treated in two Imhoff tanks with the effluent being discharged to the oxidation lagoon. Reports on the effluent quality are submitted at regular intervals.

The Water Pollution Control Commission recently approved plans for proposed new construction designed to replace virtually all of the existing waste treatment facilities.

The Company has completed studies of a lagoon aeration system for further reduction of BOD and phenols, and has made a number of improvements in in-plant waste control. Studies are now in progress on a pilot activated sludge plant.

Hastings (population 8,965)

The sewage treatment plant is designed to provide primary clarification and chlorination, and digestion of sewage solids, for sewage and waste flowing at the rate of 0.6 mgd. The design strength of the sewage is 300 mg/1 of BOD and 250 mg/1 of suspended solids. The plant is designed to produce an effluent of approximately 190 mg/1 of BOD and 75 mg/1 of suspended solids. The effluent is discharged directly to the Mississippi River near M+39.4.

H. D. Hudson Manufacturing Company (Hastings)

Untreated chromic acid wastes from this metal fabricating plant are discharged directly to the Mississippi River near the USH 61 bridge. Preliminary engineering studies on waste treatment facilities have been completed and final plans and specifications are now being prepared.

Proposed Sources of Wastes

A sewage treatment plant to serve the North Suburban Sanitary Sewage District communities has been proposed, but specific details are not available. The area to be served includes an estimated 1970 population of 210,000, and a possible ultimate tributary population equivalent of about 888,000, without regard to industrial wastes. The plant as originally proposed would be located near the SH 100 bridge with the effluent to be discharged at a point below the Minneapolis water intake near the Camden Bridge

Northern States Power Company has proposed construction of a 1,000,000 kilowatt steam electric generating plant to be located at Red Rock station in Newport near Range M+20.5. This plant is to be placed in operation by 1970.

GENERAL

River Flow* (*Data from U. S. Geological Survey Water-Supply Paper No. 1628.)

The mean flow measured in the Mississippi River at the Robert Street bridge in St. Paul during the years 1894-1897 and 1900 to 1959 was 9,832 cfs (cubic feet per second). The mean flow in the river near the Coon Rapids dam during the years 1931 to 1959 was 6,903 cfs. The mean flow measured in the Minnesota River near Carver during the years 1934 to 1959 was 2,929 cfs. Frequency curves of the monthly average flow are shown in Figures V, VI, and VII. The daily average flows for the months of August and September at the two gaging stations on the Mississippi River and at the one on the Minnesota River are given in the following table:

Flow in the Mississippi River at the Robert Street and Coon Rapids Gaging Stations, and in the Minnesota River near Carver*

August and September, 1961
Flow in cfs

Date	Robert St. Bridge		Coon Rapids Dam		Carver	
	August	September	August	September	August	September
1	4,210	1,780	2,500	1,100	2,250	821
2	4,320	1,730	2,100	1,200	3,620	717
3	5,970	1,860	2,450	1,250	4,310	685
4	6,700	1,540	2,370	1,270	4,450	637
5	6,460	1,750	2,000	1,200	4,530	629
6	6,340	1,670	1,700	1,180	4,380	557
7	5,930	1,840	1,630	1,350	3,900	541
8	5,510	1,680	1,660	1,150	3,540	605
9	5,220	1,790	1,770	1,330	3,690	661
10	5,140	1,840	1,380	1,490	3,390	645
11	4,750	2,180	1,600	1,700	2,900	637
12	4,300	2,640	1,600	2,090	2,730	597
13	3,990	2,520	1,320	2,050	2,510	637
14	3,790	2,210	1,600	1,850	2,270	845
15	3,640	3,050	1,400	2,350	2,070	901
16	2,980	3,140	1,320	2,200	1,850	1,040
17	2,760	2,900	1,070	2,050	1,660	1,360
18	2,800	2,900	1,230	1,750	1,580	1,400
19	2,680	3,010	1,400	1,780	1,590	1,260
20	3,410	2,430	2,000	2,240	1,660	1,110
21	2,930	3,440	1,360	2,460	1,590	976
22	2,580	3,260	1,110	2,480	1,520	933
23	2,450	3,230	1,240	2,390	1,500	893
24	2,440	2,950	1,200	2,360	1,410	861
25	2,470	2,960	1,270	2,300	1,320	829
26	2,560	2,920	1,400	2,200	1,220	797
27	2,230	2,560	1,300	2,000	1,160	741
28	2,270	2,440	1,330	2,100	1,110	741
29	2,120	3,100	1,190	2,300	1,040	733
30	1,920	2,990	1,120	2,350	1,000	749
31	1,800		1,100		917	
Average	3,764	2,477	1,540	1,851	2,344	818

***Provisional data from St. Paul office of U.S. Geological Survey.**

It can be seen from the frequency curves that the monthly average flow in the Mississippi River near the Coon Rapids dam and at the Robert Street bridge in August, 1961, was exceeded in approximately 97 per cent and 84 per cent, respectively, of the months of record, based on July, August and September averages. At these same locations, the monthly average flow in the river in September, 1961, was exceeded in approximately 96 per cent and 93 per cent, respectively, of the same months of record. The average daily flow for this survey period was 2,391 cfs at the Robert Street bridge and 1,650 cfs near the Coon Rapids dam. From these figures it is evident that the flow in the river during this survey was considerably less than the average for this period of the year, based on available records.

The minimum daily average flow recorded at the Robert Street bridge as shown in the available records was 632 cfs, while the maximum daily average flow was 125,000 cfs. The minimum daily average flow ever recorded at the gaging station near the Coon Rapids dam was 586 cfs, while the maximum daily average flow ever recorded was 75,900 cfs.

Figure VIII shows the maximum period of deficient discharge in the Mississippi River near Anoka and at the Robert Street bridge in St. Paul.

Weather

Rainfall data in the survey area for the months of August and September 1961 are as follows:

Precipitation in Vicinity of the Metropolitan Area

August and September, 1961*

Station	Monthly Total (inches)		Total Over Survey Period (inches)
	August	September	Aug. 22 to Sept.27, 61
Chaska	2.30	4.15	3.46
Elk River	1.96	4.70	4.95
Minneapolis WB AP	2.38	3.01	3.00
Rosemount Agri. Exp. Station	2.01	2.86	2.60
St. Paul	1.34	2.64	2.68
Stillwater	1.87	2.97	3.06

*From U. S. Dept. of Commerce, Weather Bureau, Climatological Data, Minnesota.

The average summer precipitation from April to October is approximately 22 inches which is an average of about 3 or 4 inches per month. The daytime temperatures during the survey were generally about normal, varying from 50° to 93° F. The temperature of the river water varied in the August part of the survey from 73° to 80° F and in the September part of the survey from 57° to 77° F, with an average of approximately 71° F for the entire survey.

Description of River

The Mississippi River rises in Hernando de Soto Lake in Becker County and flows 2,364 miles to the Gulf of Mexico. Approximately 510 miles, or nearly 22 per cent, is above the Metropolitan Area. The drainage area above Minneapolis is about 19,400 square miles and above St. Paul, including the Minnesota River watershed, is 36,800 square miles.

The Mississippi River has an average slope of about three feet per mile between Minneapolis and the Crow Wing River. Between the Crow Wing River and Lake Bemidji the area drained is largely lakes and swamps, and the slope of the river is little more than 0.6 foot per mile. Between Lake Bemidji and Lake Itasca, the slope increases slightly and averages 1.3 feet per mile. The sections involved in this survey extend from the outlet of the Rum River for approximately 60 miles through the Metropolitan Area to the junction with the St. Croix River. This section of river is characterized by relatively steep slopes, and includes Upper and Lower St. Anthony Falls Lock and Dam, Lock and Dam No. 1 at the Ford plant and Lock and Dam No. 2 at Hastings.

Uses of the River

For the purposes of this report, the river in the survey area has been divided into three sections. Section one is from the Rum River in Anoka to the Upper Lock and Dam of St. Anthony Falls, Minneapolis. Section two is from the Upper Lock and Dam of St. Anthony Falls to the outfall of the MSSD sewage treatment plant in St. Paul. Section three is from the outfall of the MSSD sewage treatment plant in St. Paul to the junction with the St. Croix River below Hastings.

The first section of the river is partly in residential areas and partly in an industrial area in north Minneapolis. This section is the major surface source for the Metropolitan Area water supply. At the present time, commercial traffic is not possible in the upper portion of this section (above the Soo Line Bridge in north Minneapolis);

however, considerable commercial use is expected on the river just above St. Anthony Falls when the Upper Harbor project is completed. In a report submitted to Congress, set forth in House Document 33, 85th Congress, first session, on the proposed nine foot channel extension in Minneapolis, the USCE (U.S. Corps of Engineers) estimated that a movement of 2,060,000 tons per year to the area above the St. Anthony Falls could be expected. A number of small pleasure boats use the river throughout this section. It is possible that marinas and public boat launching ramps may be provided above the Falls which may result in an increase in the number of small boats in this section.

The second section of the river is located entirely in the Minneapolis-St. Paul area. In the river from the Minnesota River junction to the MSSD plant, water transportation of commercial products is the predominant use. The products include coal, petroleum, grain, etc. With the completion of larger grain terminals, additional sand and gravel facilities, and increasing volumes of coal needed in the area, the commercial use of the river is definitely increasing. In anticipation of such increase, the USCE, at the request of the Port Authority of St. Paul, held a public hearing in December, 1961, on proposed development of Pig's Eye Lake for additional harbor capacity.

In this same section, there is a large amount of pleasure boat traffic. There are about five private marinas and the municipal marina at Harriet Island is currently being enlarged substantially. During the survey, a number of water skiers were noted in the area.

The third section of the river passes through residential and industrial areas south of St. Paul and wooded terrain in the Pine Bend area. It is generally used for the barge transportation of commercial products such as grain, coal, sand, and gravel, etc. There is a considerable amount of pleasure boat traffic, primarily boats passing through to the St. Croix or Lower Mississippi River. There are also a number of marinas in this section.

Relatively little recreational and commercial fishing is done at present in the river in the Metropolitan Area. Most of the recreational fishing is done in Sections one and two, and in the lower end of Section three. A fishery survey was made in the upper 12 miles of Section one by the Surveys and Inventories Unit of the Division of Game and Fish, Minnesota Department of Conservation, in August, 1960. The results of the survey showed that carp were taken in the greatest number and that the fish population was composed of species normally present in large streams. There were a large number of small mouth bass and blue gills taken, indicating that this section of the river affords game fish habitat of good quality (see Appendix D).

Municipal Information

There are 114 incorporated municipalities in the seven-county Metropolitan Area, of which 13 directly border on the Mississippi River in the survey area. The latter communities with their means of sewage disposal are listed in Table 3. These communities, excluding the two central cities of St. Paul and Minneapolis, are primarily residential. The townships bordering Section three are sparsely populated but the population is growing rapidly. In recent years considerable industrial growth has taken place in some of the suburban areas. The most significant developments of the past decade have been located in the Pine Bend area, Roseville, St. Louis Park-Hopkins area, Golden Valley, Maplewood, and the Minneapolis-St. Paul midway area. An extensive population study, including trends, municipal data, etc., is presented in a report(1) on the expansion of sewage works in the Metropolitan Area by the MSSD. Basic studies in these fields have been completed and are being made by the Metropolitan Planning Commission.

As shown in Table 3, the majority of the communities bordering the river have only individual residential sewage treatment facilities which consist of septic tanks and soil absorption fields. Four of the communities have existing contracts with either Minneapolis or St. Paul and discharge their sewage through these sewers to the MSSD sewage treatment plant. Five of the communities are either entirely or partially served by separate municipal sewage treatment plants.

Municipal Water Supply

The Mississippi River in the survey area is the sole water supply source for Minneapolis and supplementary source for St. Paul. Both Minneapolis and St. Paul supply water by contract to some of their suburbs. Minneapolis takes its water directly from the river to the Fridley softening plant which serves two separate filtration plants located in Fridley and Columbia Heights. Rated capacity of the softening plant is 120 mgd, while the combined capacity of the filtration plants amounts to 158 mgd.

The St. Paul raw water pumping station is located approximately four miles above the Minneapolis intake. The water is pumped through conduits to a series of lakes which serve as impounding reservoirs. The river water augments water taken from watersheds directly north of St. Paul. The lake system is physically divided into two separate basins; i.e., the Vadnais Lake system and the Centerville system.

The water from the Vadnais Lake system flows directly to the water treatment plant and the water in the Centerville system is pumped into the Vadnais Lake chain. St. Paul water is treated at the McCarron's Station. The rated capacity of the plant is approximately 100 mgd.

The following table lists the communities bordering the Mississippi River which have public well water systems:

Anoka
Coon Rapids
Fridley
Brooklyn Center
South St. Paul
St. Paul Park
Hastings
Cottage Grove Township
(Thompson Estates)

The remaining communities bordering the Mississippi River have no public water systems but depend upon well water supplies serving individual homes.

Water used for commercial, industrial, domestic, community and miscellaneous purposes in the Metropolitan Area averages approximately 233 mgd. Of this amount, approximately 97 mgd comes from surface sources. The demand for surface water for municipal systems in this area will probably increase during the next 20 years to an average of about 200 mgd. In units in which stream flow is commonly measured, the estimated average demand for surface water for municipal supply in 1980 is equivalent to 310 cfs with a maximum demand of nearly 620 cfs. After completion of the navigation locks at St. Anthony Falls, a flow of about 350 cfs will be required for operation of the locks. On this basis, a flow of 1,000 cfs in the Mississippi River above Minneapolis will barely meet the maximum needs for these two purposes alone.

The water supply needs of the Metropolitan Area have recently received intensive study by the Department of Conservation. Results of these studies are reported in Bulletin 11, 1961, which is available from the Department of Administration.

It should be pointed out that the river water supply is or may be used not only for residents of St. Paul and Minneapolis but by a majority of residents of the suburbs. A high degree of protection of the quality of these waters is required to hold to a minimum possible health hazards to these users.

Selection and Designation of Sampling Stations

A mileage index system is used for the purpose of identifying the sampling ranges, individual stations, sewer outlets, and other points of interest on the river and tributaries. The system involves the use of the letter M to identify stations on the Mississippi River, followed by a number which represents the distance in miles from the lower Northern Pacific Railway Bridge below St. Anthony Falls. The zero mileage point was taken at this railroad bridge because it is used as the zero mileage point for the entire Mississippi River by the U. S. Corps of Engineers. It previously represented the upper limit of navigation and channel improvement. The plus sign between the M and river mileage identifies stations below the zero mileage point and the minus sign identifies stations above the zero mileage point. The ranges are divided into equal sections by points from left to right (facing downriver), with the first point or station on the left end of the range being numbered 1, the next station numbered 2, etc. These are listed as subscripts to the mileage, for example: $M+20.8_1$. Samples taken at varying depths are identified with a "d" following the corresponding surface station number. A "c" following the range mileage designation represents a composite of the samples collected at the stations on the sampling range.

Sampling Procedures

The majority of the river samples were collected from an 18-foot Aluma-Craft boat equipped for all types of water and bottom sampling. Surface samples collected for bacteriological analysis were taken with a "dip-stick" approximately three to four feet out from the moving boat and only a few inches below the surface. The other samples were generally collected at approximately 0.6 of the depth at the station. The depth samples for bacteriological analysis were collected with a special spring-loaded depth sampler at the same depth as the water chemistry samples. The water samples for chemical analysis were collected at approximately 0.6 depth with a standard "double" sampler. Generally, the water chemistry samples collected on the ranges or cross-sections were composited from thoroughly mixed individual samples. The bottom samples were obtained by means of a Peterson dredge or Ekman bottom sampler.

The water samples were kept in iced cases until they could be transported to the Department laboratory in Minneapolis. The bacteriological samples were examined and processed within 24 hours after collection. The bottom fauna samples were preserved with formalin and stored for later examination.

FIELD OBSERVATIONS

Sewer Outfalls

There are approximately 65 sewer outfalls to the Mississippi River in Minneapolis and St. Paul. A list of the sewers is given in Table 4 and their locations are shown in Figures IX, X, and XI. The sewer systems in the two core cities of Minneapolis and St. Paul were originally designed to carry combined sewage and storm water to the river. When interceptor sewers were constructed to carry the sanitary sewage to the MSSD plant, regulators were installed at the junctions of the new interceptors and the old trunk sewers. These devices divert excess flows directly to the river. Because of occasional faulty operation of the regulating devices, incomplete separation, and generally increased flows during and after rains, there is at present a considerable amount of flow to the river from various sewers. Personnel of the MSSD regularly inspect the sewer outfalls, record from which sewers there is flow, estimate the rate of flow, and describe the physical characteristics of the flow. This information is periodically reported to this Department (see Appendix E).

In July, 1961, a representative of this Department accompanied MSSD personnel during their inspection. At this time, a number of the sewers were seen to be discharging, and the flow from the Minnehaha, Davern, and Robie sewers had the physical appearance of raw sewage.

River Section One

From the boat, the water generally appeared to be turbid and colored; but when viewed in the sample bottles, the water was fairly clear. A large oil slick was seen near Nicollet Island and signs of oil accumulation on the shore. A sewer in this area was found to be discharging approximately 300 gpm (gallons per minute) of waste containing about 125 mg/1 of oil directly to the river (Range M-1.5).

The Minneapolis water purification plant was apparently discharging supernatant from the lime sludge settling pond serving the softening plant to the Mississippi River just below the purification plant. The river water in this area was cloudy and murky, and a large quantity of the lime sludge was found on the bottom of the river. Just below the Camden bridge, a sewer (M-4.9) was discharging to the river from the left bank. The effluent had a very murky appearance, which was probably caused by the presence of filter backwash water from the Columbia Heights filtration plant of the Minneapolis water system. The river water in the vicinity of this sewer appeared to be very turbid.

There was a considerable amount of refuse on both banks of the river between the Broadway and Lowry Avenue bridges. Some of the refuse such as cans, brush, etc., had been washed into the river. No other visible evidence of unsatisfactory conditions was found in the investigation of the shorelines in this section of the river. This part of the river is being improved for navigation by the dredging of a nine-foot channel. Section one is expected to be opened to navigation in 1962.

River Section Two

From the boat the water appeared to be turbid and greenish, and some of the samples, when viewed in the sample bottles, also were greenish.

The bottom in this section of the river was found to consist generally of fine sand and mud. No sludge deposits were found, although some of the mud had a very strong odor, probably from decaying organic matter.

The following table shows the sewers which were found to be discharging to the river at this time, the estimated flow, physical appearance of the flow, and the results of analysis of random samples of the flows:

Sewer Outfall	Estimated Flow (gpm)	Appearance	Coliform Group Organisms (MPN/100 ml)*
Tenth Avenue S.E.	1,500-1,700	Feathers, cloudy, turbid	3,100
Fifth Street So.	1,600	Cloudy	170,000
Bridal Veil Falls	2,000	Clear	780
Portland Avenue	300	Gray, cloudy	>24,000,000
Eustis Avenue	-	Yellowish-brown	20,000
Otto W.	1,200	Gray, cloudy	5,400,000
Randolph W.	300	Gray, cloudy	>24,000,000
38th Street	-	Gray, cloudy	16,000,000
Minnehaha (small opening)	150-200	Cloudy, sewage solids	>24,000,000
Davern	150	Cloudy	5,400,000
St. Peter	100	Fairly clear	490,000
Eagle	200-300	Cloudy	1,100,000
Moses	50-100	Cloudy	780
Trout Brook at river	-	Slightly cloudy	2,400,000

*Most probable number per 100 milliliters.
> - Means greater than.

From the data it can be seen that the majority of the flows probably contained some sewage. The higher coliform values are in the ranges normally found in raw sewage.

During the investigation a number of water skiers were noted near the Minnesota River junction. Also in this area, near Hidden Falls, and below the Ford dam, large numbers of people were using the river banks for picnicking. Considerable pleasure boating is done here, and there is a large new marina near the Davern sewer outfall which was harboring approximately 70 boats at the time of the survey.

River Section Three

This section of the river, extending from the MSSD sewage treatment plant to the St. Croix River junction, was in very poor physical condition. Discoloration of the river by the MSSD and South St. Paul effluent was evident. This entire section of the river appeared cloudy and turbid from the boat, and the samples, when viewed in the sample bottles, appeared to be in the same condition. The river appeared to be in a slightly better condition in the Hastings-St. Croix River area. Occasionally large oil slicks were noted on the water surface, apparently from the barges using the river.

The river bottom from the MSSD plant to approximately M+32 was covered with a heavy black sludge. The heaviest deposits of sludge were found below the South St. Paul waste treatment plant where depths of sludge greater than 2.0 feet existed. From this point downstream, the sludge depths decreased steadily until relatively small quantities of sludge were found between M+32 and the Hastings dam. In the area of the greatest sludge depths below the South St. Paul waste treatment plant, the water surface was covered with small gas bubbles, caused by the decomposition of sludge on the bottom. In many places the banks held accumulations of black sludge which yielded odorous gases when disturbed.

In order to determine the nature and extent of bottom deposits in the river, a two month special study was conducted in 1959 by the University of Minnesota for the MSSD, as part of the general river studies mentioned earlier. Their report states that "little or no bottom deposits were found above the Minneapolis-St. Paul Sanitary District treatment plant outfall. The river bottom immediately above the outfall consisted of rock and sand with but a trace of organic deposits and with a faint organic odor. The first real evidence of a bottom deposit was found at Station M+17.0 along the east shore of the river. From this point downstream to M+37.5 bottom deposits up to 4.5 feet deep were found to range from one side of the river to the other varying in width and depth." This generally agrees with conditions found by this Department during the 1961 investigations.

Two submerged sewer outfalls were noted in the river in the South St. Paul area near the Armour and Company, Inc., and Swift and Company, Inc., meat packing plants. In both of these areas, the river water was highly colored, and solids, characteristic of packinghouse wastes, were seen.

Very little recreational use is made of this section of the river. During the survey only a small number of pleasure boats were noted passing through and no one was seen using the river for swimming or fishing.

Growths of sewage fungus were seen near the shore below the Hastings sewage treatment plant outfall.

Cross-section depth recordings were made at each sampling range with a sonic depth sounder. The bottom profiles are shown in Figures XII, XIII, and XIV.

Inspection Trip

On August 24, 1961, the Water Pollution Control Commission and staff members of this Department traveled by boat on the Mississippi River from the University campus to the Hastings lock and dam to observe the physical condition of the river at first hand. The trip covered most of Sections two and three.

DISCUSSION OF ANALYTICAL DATA

The results of the laboratory analysis of the samples are listed in Tables 5, 6, and 7 and shown in Figures XV, XVI, XVII, XVIII, XIX, and XX.

Bacteriological

The results of the examination of the bacteriological samples are expressed in terms of coliform group organisms as the MPN/100 ml (most probable number per 100 milliliters of sample). The undifferentiated coliform group is ordinarily used as an indicator of the presence of fecal material or sewage. Bar graphs showing the coliform group levels found at each range are shown in Figures XV, XVI, XVII, and XVIII. It should be noted that different scales are used for each graph.

Coliform organisms found in the individual samples from Section one varied from less than 200 to 54,000 MPN/100 ml, which is not unexpected in view of the discharges to the river. The average concentration of coliforms across a range increased to a maximum of approximately 22,700 MPN/100 ml near the St. Paul water intake. The minimum average concentration of coliforms found in the samples collected in a single sampling range was approximately 1,470 MPN/100 ml, which was near the Minneapolis water purification plant. The concentration of coliform organisms in the random samples collected from the flow in the sewers discharging in Section one was generally low, and did not appear indicative of fecal contamination.

From the Minneapolis water purification plant (Range M-6.2) the concentration of coliforms found in the samples taken down river steadily increased to a maximum of more than 24,000,000 MPN/100 ml below the Minneapolis-St. Paul sewage treatment plant (M-20.8).

The concentration of coliform organisms in the samples from Section two varied from 1,700 to 240,000 MPN/100 ml. A number of the storm sewer flows in this section of the river contained very high coliform concentrations. The data for these samples are given in the section on field observations. It appears from the analytical data and the field observations that the flow from a number of the sewers contained fecal material which was responsible for the high coliform concentrations. The Minnehaha sewer (small opening), for example, was observed on three different occasions and each time the flow had the physical appearance of raw sewage.

The average coliform concentration found in the samples from this entire section was much greater than was found in Section one, which was probably because of the storm sewer flows. As shown in the bar graphs in Figure XVI there was a consistent increase in coliform concentration going down-river through this section, with maximum average values of 45,000 and 24,300 MPN/100 ml found at Ranges M+13.8 and M+16.6, respectively. The highest concentration of coliforms in this section of the river (240,000 MPN/100 ml) was found in a sample collected at M+6.0_2, which was just below the Minnehaha sewer outfall.

At a number of the ranges, depth samples were collected in the main channel for bacteriological analysis. From the data, there appears to be very little specific relation between the coliforms found in the depth samples and those found in the corresponding surface samples, i.e., neither consistently high nor low in relation to the surface sample. The concentrations were, however, relatively the same in magnitude, i.e., where the coliform concentration in the surface sample was high the coliform concentration in the depth sample would also be high.

The coliform organisms found in the samples collection in Section three varied from 450 to greater than 24,000,000 MPN/100 ml. As expected, the highest concentrations were found in the ranges below the MSD, the South St. Paul, and St. Paul Park sewage treatment plants. From these maximum values (greater than 24,000,000 MPN/100 ml at Range M+20.8, 21,300,000 MPN/100 ml at Range M+22.7, and 19,350,000 MPN/100 ml at Range M-23.6), the average coliform concentration steadily decreased to 2,550 MPN/100 ml at Range M+42.0. Chlorination of the effluent was not being done at any of these plants at the time of the survey. There was a slight increase in coliforms in the samples collected below the Hastings treatment plant and below the mouth of the Vermillion River (10,700 MPN/100 ml) as compared to those found in the samples collected above Hastings at Range M+39.1 (3,630 MPN/100 ml).

The coliforms in the depth samples and those found in the corresponding surface samples were relatively of about the same magnitude in Section three also, but there was no consistent relationship of high or low between the coliforms in the depth samples in comparison with those in the corresponding surface samples. It appears from the data that at the time of the investigation there was no significant stratification of the surface currents and depth currents on most of the river in respect to content of coliform organisms.

Dissolved Oxygen

Samples for DO (dissolved Oxygen) analysis were generally collected at the same stations as the samples for bacteriological analysis. The concentration of dissolved oxygen in Section one varried from 7.0 to 11.8 mg/1 with an average of approximately 9.8 mg/1 for all of the samples collected in the river in both the 1960 and 1961 surveys. The values found in 1961 were slightly higher than those in 1960, although the per cent of saturation was about the same, because of lower water temperatures in 1961. In no place in the river in this section was there any serious oxygen deficiency, nor did there appear to be any significant change in DO content from the left to the right side of the river at any of the sampling ranges. All DO samples were collected, however, in daylight hours only.

In the upper part of Section two, as can be seen in Figure XIX, the concentration of dissolved oxygen found in the samples was generally at about the same level as in Section one, but the dissolved oxygen at Ranges M-13.8 and M-16.6 was much lower. At these ranges the dissolved oxygen averaged 5.5 and 5.2 mg/1, respectively, which is decrease of more than 3 mg/1 from the next range upstream (M-9.1). This may be attributed to the combined effects concentrations were found in the ranges below the MSSD, the South St. Paul, and St. Paul Park sewage treatment plants. From these maximum values (greater than 24,000,000 MPN/100 ml at Range M+20.8, 21,300,000 MPN/100 ml at Range M+22.7, and 19,350,000 MPN/100 ml at Range M-23.6), the average coliform concentration steadily decreased to 2,550 MPN/100 ml at Range M+42.0. Chlorination of the effluent was not being done at any of these plants at the time of the survey. There was a slight increase in coliforms in the samples collected below the Hastings treatment plant and below the mouth of the Vermillion River (10,700 MPN/100 ml) as compared to those found in the samples collected above Hastings at Range M+39.1 (3,630 MPN/100 ml).

The coliforms in the depth samples and those found in the corresponding surface samples were relatively of about the same magnitude in Section three also, but there was no consistent relationship of high or low between the coliforms in the depth samples in comparison with those in the corresponding surface samples. It appears from the data that at the time of the investigation there was no significant stratification of the surface currents and depth currents on most of the river in respect to content of coliform organisms.

of the discharge from storm sewers, and the flow from the Minnesota River. Records of dissolved oxygen found in samples collected routinely by this Department at Shakopee as part of the water quality sampling program, show values since 1956 ranging from 3.8 to 8.0 mg/1 and averaging approximately 6.0 during the months of June, July, August, and September. Lower values would be expected in the lower part of the river above the confluence with the Mississippi River.

The concentration of dissolved oxygen in the samples collected in Section two varied from 4.9 to 12.1 mg/1 with an overall average of approximately 8.8 mg/1. The dissolved oxygen averaged about 10.5 mg/1 above the Minnesota River junction and about 6.5 mg/1 below. At no point in the river in Section two at this time was there serious oxygen depletion such as to interfere with fish life. However, it should be borne in mind that sampling was limited to a short period and conditions may vary for many reasons.

In Section three the concentration of dissolved oxygen in the samples varied from none found to 15 mg/1, with the highest concentration being found in Range M+37.0 in the shallow river backwater called Lake Rebecca, near Hastings. Virtually total oxygen depletion was found from Range M+20.8 through M-28.3 below the MSSD and

South St. Paul plants, although at some of these ranges low concentrations of dissolved oxygen were found in backwaters off the main river channel. At Range M+29.4 a low concentration of dissolved oxygen was found in all the samples and from this point the oxygen increased steadily to the end of Section three below the junction with the St. Croix River.

Figure XX shows how the dissolved oxygen concentrations varied across the river in the same range. It can be seen that at Ranges M-13.8 and M-16.6 above the MSSD plant there was little different from one side to the other. At Range M-17.3 below the MSSD sewage treatment plant and above the South St. Paul waste treatment plant there was a significant change with the lowest DO values being found on the left side of the river. This would seem to indicate that the effluent of the MSSD plant channeled along the left side of the river for some distance before it became completely dispersed. At Range M+20.8 below the South St. Paul waste treatment plant there was a complete oxygen deficiency at all of the stations in the range. The BOD values reflect the addition of wastes from the right bank.

In the report "Pollution and Recovery Characteristics of the Mississippi River "(2) records of dissolved oxygen found in the river are used as a basis for determining the river deoxygenation rates. This involved the manipulation of various river characteristics such as temperature, flow, channel width, reaeration, etc., with the deoxygenation rates of primary settled effluent, activated sludge plant effluent, and trickling filter plant effluent to determine the theoretical oxygen sag curves in the river for different degrees of treatment for each type of plant at various points of discharge in the Metropolitan Area. From these results, it is possible to determine the degree of treatment necessary to maintain given standards of DO. The deoxygenation rates thus calculated were based on data collected by personnel of the MSSD over a period of almost 25 years.

This Department, on the basis of this and past investigations, is in general agreement with the river sampling techniques and laboratory procedures used by the MSSD to compile the data, although the data have certain limitations which should not be overlooked. Personnel of this Department have on numerous occasions accompanied MSSD personnel on the sampling trips and have split samples for separate analysis. The MSSD laboratory also cooperates as a participating laboratory in the United States Public Health Service Basic Water Quality Program.

It is understood that the deoxygenation rates used in the river study were based on analysis of samples collected at M+13.8 (Robert Street bridge in St. Paul). Long-term BOD analyses were made on samples collected over a number of years and the average of the results was used. The deoxygenation rates calculated for this portion of the river above any major sewage or waste discharge were then combined with the deoxygenation rates for primary settled effluent, activated sludge plant effluent, trickling filter plant effluent, etc., to obtain the deoxygenation rates used for the river below the Minneapolis-St. Paul Sanitary District sewage treatment plant and the South St. Paul waste treatment plant.

Comparison of DO and BOD data for this range (M+13.8) will generally reflect conditions at the time of this survey and those for which the deoxygenation rates were calculated. The following table summarizes average DO and BOD data for the years 1950 through 1960 for Range M+13.8 as reported by the MSSD for the months of July, August, and September:

Dissolved Oxygen and BOD Concentrations
Range M+13.8
Averages for July, August, and September (mg/l)

Year	DO	BOD
1960	7.00	3.30
1959	6.75	2.65
1958	6.80	3.10
1957	7.25	2.80
1956	7.65	2.90
1955	7.25	2.40
1954	7.55	2.90
1953	7.60	2.75
1952	8.00	2.25
1951	7.60	2.60
1950	7.90	2.25
Average	7.40	2.72

It can be seen that the average concentration of DO is higher than any found by this Department in Section three, and the average BOD reported is lower than found by this Department during the 1961 survey.

Comparison of the DO found by this Department during the survey and the DO found by the MSSD at the same ranges within the period of the survey show generally the same results. The following table shows the two sets of data for samples collected in August and September by the separate staffs:

Dissolved Oxygen Concentrations
August and September, 1961

	WPC		MSSD	
Range	DO(2)	Date	DO(5)	Date
M-6.2(1)	9.8	9-21	9.85	9-28
M+0.4	8.5	9-20	10.05	9-28
M+5.4	10.7	9-19	10.00	9-28
M+13.8	5.5	9-15	4.85	9-14
M+16.6	5.2	9-15	5.10	9-14
M+20.5(3)	0	9-14	0	9-14
M+22.7	0	9-13	0	9-14
M+26.5	0	9-11	0	9-14
M+33.9(4)	4.8	8-25	4.50	8-23
M+37.8	5.9	8-23	2.65	8-29

1 - Corresponds to Range M-5.5 used by the MSSD.
2 - Average of DO for all stations in the range.
3 - WPC range nearest this is M+20.8.
4 - WPC range nearest this is M+33.2.
5 - Single random sample.

Although some of the samples were collected at different times with slightly different river flow conditions, the results of the sampling and analyses by this Department and the MSSD staff are generally comparable. The data show a progressive degradation and some recovery in the water quality of the river in Section three.

It appears that the average long term conditions used as a basis for the calculations presented in the MSSD report on the pollution and recovery characteristics of the river are somewhat better than the actual conditions found at the time of this survey; however, it should be noted, as stated in a preceding section of this report, that river flows were unusually low at this time (see General, River Flow).

Biochemical Oxygen Demand

Figure XIX shows the BOD data for all three sections. The BOD values found in the samples collected in Section one ranged from 1.5 to 5.8 mg/1, and averaged approximately 3.9 mg/1. The BOD values in Section two ranged from 1 to 7.5 mg/1 and averaged approximately 5.0 mg/1, a moderate increase from Section one. The BOD found in samples from the flow of a number of sewers discharging to the river in Section two was generally high, indicating a probable sewage discharge. The slight overall increase of BOD in Section two, as compared to Section one, was probably the result of the discharges from these sewers.

The BOD increased significantly in Section three. The values ranged from 1 to 14 mg/1 and average approximately 9.4 mg/1. The BOD in the river below the MSSD sewage treatment plant and South St. Paul waste treatment plant was considerably higher than would be expected even in a moderately polluted river. Figure XX shows how the BOD varied across the river at sampling ranges below the plants, together with the dissolved oxygen profiles.

Analysis of samples collected in the river only a short distance away from the submerged outfalls of the South St. Paul packing plants (Ranges M+19.6 and M+20.0) showed BOD values of 30 and 55 mg/1. These are substantial values in view of the fact that the samples were collected from the river rather than the outfalls, thereby including diluting river water with the waste.

General Water Chemistry

The nutrient level of the river water, as indicated by the concentration of nitrogen and phosphorus found in the samples, varied considerably. In Sections one, two, and three the phosphorus concentrations averaged approximately 0.097, 0.18, and 0.48 mg/1, respectively, while the total nitrogen concentrations averaged 0.70, 0.80, and 3.4 mg/1, respectively, for the same sections. In each case the average concentration increased more than four times from Section one to Section three.

The phenol concentration found in one individual sample collected in Section three reached a maximum of 0.049 mg/1 (below Northwestern Refining Company at Range M+23.6) compared with others of less than 0.005 mg/1 at Range M+29.4. There was no increase in average phenol concentration found in the range across the river above the refinery as compared to the range below the refinery (0.045 mg/1 above, 0.039 mg/1 below). The average concentration in Section three was 0.024 mg/1.

The ammonia concentration found in the samples collected in Section three varied from 1.0 to 1.4 mg/1. The average concentrations found in Sections one and three were 0.03 mg/1 and 0.93 mg/1.

Bottom Muds

River bottom samples were collected at a number of stations and analyzed for total volatile matter. The samples were dried, weighed, and ashed in a furnace at 600° C for 30 minutes, re-weighed, and the difference in weight taken as the volatile matter.

Where there are heavy accumulations of organic sludge, the per cent volatile matter would be expected to be high. The following table lists the ranges sampled and the per cent volatile matter found in each sample:

Total Volatile Matter as Per Cent of Dried Sample
August, September, 1961

Range and Station	% TVM	Range and Station	% TVM	Range and Station	% TVM
$M-7.7_1$	1.4	$M+22.7_2$	10.5	$M+31.9_2$	8.2
$M-6.2_2$	0.82	$M+22.7_3$	3.4	$M+31.9_3$	4.3
$M-6.2_3$	1.8	$M+23.6_1$	8.1	$M+31.9_4$	7.7
$M-2.2_1$	4	$M+23.6_2$	9.2	$M+31.9_5$	1.4
$M-2.2_2$	1.3	$M+23.6_3$	6.3	$M+31.9_6$	6.8
$M-2.2_3$	2.4	$M+26.5_1$	3.6	$M+33.2_1$	2.5
$M+13.8_1$	7.1	$M+26.5_2$	1	$M+33.2_2$	1.0
$M+13.8_2$	5.4	$M+26.5_3$	5.4	$M+33.2_3$	6.9
$M+13.8_3$	4.2	$M+26.5_4$	12	$M+37.0_2$	4.0
$M+16.6_1$	23.1	$M+28.2_2$	7.0	$M+37.0_3$	8.8
$M+16.6_2$	5.9	$M+28.2_3$	7.4	$M+37.0_4$	7.1
$M+16.6_3$	5.3	$M+28.2_4$	2.0	$M+37.0_6$	7.4
$M+17.3_1$	10.3	$M+28.2_5$	5.8	$M+39.1_1$	1.4
$M+17.3_2$	15	$M+29.4_2$	9.1	$M+39.1_2$	2.1
$M+17.3_3$	16.2	$M+29.4_3$	5.0	$M+39.1_3$	1.2
$M+20.8_1$	9.8	$M+29.4_5$	7.4	$M+39.8_2$	6.6
$M+20.8_2$	5.1	$M+29.4_6$	0.9	$M+39.8_3$	1.8
$M+20.8_3$	10.3	$M+29.4_7$	4.7	$M+42.0_2$	4.4
$M+22.7_1$	8.4	$M+31.9_1$	5.2	$M+42.0_3$	0.6

It can be seen from the table that there was a definite increase in the per cent volatile matter of the bottom mud below the MSSD and South St. Paul treatment plants. The bottom samples collected in Section one averaged approximately 2% volatile matter, compared with approximately 8.5% in Section two, and approximately 6% in Section three. Much of the volatile matter found in Sections one and two probably can be attributed to decaying organic matter deposited in slack water out of the main channel of the river and in the pools of the St. Anthony and Ford dams.

SUMMARY AND CONCLUSIONS

1. The 1961 survey on the Mississippi River extended from the junction with the Rum River to the junction with the St. Croix River below Hastings, and comprised a period of several weeks. For the purposes of the survey, the river was divided into Sections one, two, and three, from Anoka to St. Anthony Falls, the Minneapolis-St. Paul Sanitary District plant, and the mouth of the St. Croix River below Hastings, respectively. Samples for chemical, bacteriological, and biochemical analysis were collected at a number of stations located at representative ranges throughout the survey area.

Bottom mud samples were also collected at all of the ranges for total volatile matter analysis. Physical measurements were made of sludge depth on the river bottom in that part of the river below the Metropolitan Area. The dissolved oxygen and temperature were measured in the field, other analyses were made in the Minneapolis laboratory of the Division of Environmental Sanitation of the Department of Health.

2. The physical appearance of the river in Sections one and two was relatively good, with the exception of a small area below the Minneapolis water purification plant, and localized areas where refuse had been dumped on the river banks. Section three was in very poor condition. Heavy deposits of sludge were encountered from below the outfall of the Minneapolis-St. Paul Sanitary District sewage treatment plant to the Hastings dam. In the vicinity of Range M+20.8 (near South St. Paul) the entire river was covered with gas bubbles arising from the decomposition of sludge on the bottom.

3. The effluents of the Minneapolis-St. Paul Sanitary District sewage treatment plant and the South St. Paul waste treatment plant were found to be materially affecting the condition of the river. An excessive increase in coliform group organisms and in biochemical oxygen demand was found in the river below these plants, together

with a zone of total oxygen depletion which was followed by partial recovery. Uncontrolled discharges of sewage and wastes from storm sewers and other sources also contributed significantly to deterioration of river conditions in the river upstream in the Metropolitan Area.

4. Bacteriological sampling and analysis showed a generally consistent increase in coliform group organisms going downstream throughout Sections one and two to Range M+23.6. From this point on, the coliform organisms steadily decreased in number. High coliform group organism levels were found in every section of the river and are considered indicative of a potential health hazard to anyone coming into intimate contact with the river water. Coliform concentrations at some ranges in Section one were much higher than in considered desirable in a source of water supply and any increase would present an added hazard to the safety of the water supply.

5. The dissolved oxygen concentrations were found to be relatively high in Section one, averaging approximately 9.8 mg/1. In Section two the overall dissolved oxygen concentration averaged approximately 8.8 mg/1. In Section three there was found to be total oxygen depletion from Range M+20.8 through Range M+28.3, or a distance of 7½ miles. From this point, the dissolved oxygen content began to increase, recovering to approximately 5.0 mg/1 immediately

below the junction with the St. Croix River.

6. The results of this survey show that the basic data and information contained in the report "Pollution and Recovery Characteristics of the Mississippi River", sponsored by the Minneapolis-St. Paul Sanitary District, 1961, are in reasonable accord with conditions found by this Department to be existing at this time, insofar as they may be related, on the basis of comparable conditions.

7. In terms of coliform group organisms, the pollution of Sections one, two, and three is described as moderate, severe, and gross, respectively, while in terms of dissolved oxygen and biochemical oxygen demand the pollution of Sections one, two, and three is described as light, moderate, and gross, respectively.

MINNESOTA DEPARTMENT OF HEALTH
Division of Environmental Sanitation
Section of Water Pollution Control

Mississippi River Survey, from
Rum River to Coon Rapids Dam
July and August, 1960

Table 1

SAMPLING STATIONS

Range	Station	Description
M-18.8	1-3	In the Mississippi River at the Champlin Bridge (USH 169), at equal intervals from left to right.
	c	Same as above. Composite of Stations 1, 2, and 3.
M-18.3	1-3	In the Mississippi River approximately 100 yards below the junction with the Rum River, at equal intervals from left to right.
	c	Same as above. Composite of Stations 1, 2, and 3.
M-17.3	1-3	In the Mississippi River approximately 1½ miles southeast of the Champlin bridge (USH 169), at equal intervals from left to right.
M-14.4	1-3	In the Mississippi River approximately 3/4 mile above the Coon Rapids dam, at equal intervals from left to right.
	c	Same as above. Composite of stations 1, 2, and 3.

MINNESOTA DEPARTMENT OF HEALTH
Division of Environmental Sanitation
Section of Water Pollution Control

Mississippi River Survey, from
Coon Rapids Dam to St. Croix River
August & September, 1961

Table 2

SAMPLING STATIONS

Range	Station	Description
M-12.9	1-2	In the Mississippi River approximately 3/4 mile below the Coon Rapids dam, at equal intervals from left to right.
	c	Same as above. Composite of Stations 1 and 2.
M-9.8	1-3	In the Mississippi River at the St. Paul pumping station, at equal intervals from left to right.
	c	Same as above. Composite of Stations 1, 2, and 3.
M-7.7	1-3	In the Mississippi River approximately ½ mile above the USH 100 bridge, at equal intervals from left to right.
	c	Same as above. Composite of Stations 2 and 3.
M-6.2	1-3	In the Mississippi River approximately 50 yards above the Minneapolis water treatment plant raw water intake, at equal intervals from left to right.
	c	Same as above. Composite of Stations 1, 2, and 3.
	2d	Same as above at a 3-foot depth below Station 2.
M-4.9		Columbia Heights line below the Camden Bridge.
M-2.3		Sewer discharging to the Mississippi River approximately 75 yards below the Broadway bridge.
M-2.2	1-3	In the Mississippi River approximately 350 yards above Bassetts Creek, at equal intervals from left to right.
	c	Same as above. Composite of Stations 1, 2, and 3.
	2d	Same as above at an 8-foot depth below Station 2.
M-1.7	1-3	In the Mississippi River approximately 500 yards below Bassetts Creek, at equal intervals from left to right.
	c	Same as above. Composite of Stations 1, 2, and 3.
	2d	Same as above at an 8-foot depth below Station 2.
M-1.5		Nicollet Island sewer discharging to the east channel of

Table 2 (cont'd)

SAMPLING STATIONS

Range	Station	Description
M-0.1		10th Ave. S.E. sewer approximately 150 feet below the Tenth Avenue Bridge.
M+0.1	1	Sewer on left bank approximately 100 feet below the Northern Pacific Railroad bridge.
M+0.1		Sewer on left bank approximately 150 feet below the Northern Pacific Railroad bridge.
M+0.4	1-2	In the Mississippi River at the Washington Avenue bridge, at equal intervals from left to right.
	c	Same as above. Composite of Stations 1 and 2.
	2d	Same as above at a 12-foot depth below Station 2.
M+0.6		Fifth Streets sewer directly below Fairview Hospital.
M+1.5	1-2	In the Mississippi River at the Franklin Avenue bridge, at equal intervals from left to right.
M+1.5		Bridal Veil Falls sewer
M+3.1	1-2	In the Mississippi River at the Lake Street-Marshall Avenue bridge, at equal intervals from left to right.
	c	Same as above. Composite of Stations 1 and 2.
	1d	Same as above at a 12-foot depth below Station 1.
M+3.2		Eustis Avenue sewer on St. Paul side.
M+3.8		Portland Avenue sewer on St. Paul side.
M+4.1		38th Street sewer on Minneapolis side.
M+4.6		Randolph W. sewer on St. Paul side.
M+5.2		Otto W. sewer above the Ford Bridge on St. Paul side.
M+5.4	1-3	In the Mississippi River at the Ford Bridge, at equal intervals from left to right.
	c	Same as above. Composite of Stations 1, 2, and 3.
M+5.6		Sewer below Ford hydro-electric plant.
M+5.8		Minnehaha sewer (small opening) below the Ford dam on the Minneapolis side.

Mississippi River Survey, from
Coon Rapids Dam to St. Croix River
August & September, 1961

Table 2 (cont'd)

SAMPLING STATIONS

Range	Station	Description
M+6.0	1-2	In the Mississippi River approximately ½ mile below the Ford lock and dam, at equal intervals from left to right.
	c	Same as above. Composite of Stations 1 and 2.
	2d	Same as above at a 10-foot depth below Station 1.
M+7.5	1-3	In the Mississippi River at the Seventh Street bridge in St. Paul, at equal intervals from left to right.
	c	Same as above. Composite of Stations 1, 2, and 3.
	2d	Same as above at a 6-foot depth below Station 2.
M+7.9		Davern sewer on left bank.
M+8.0		At the outlet of the marina near the extension of Davern Street in St. Paul.
M+9.1	1-3	In the Mississippi River approximately 600 feet below the junction with the Minnesota River, at equal intervals from left to right.
	c	Same as above. Composite of Stations 1, 2, and 3.
	2d	Same as above at a 12-foot depth below Station 2.
M+11.6		Outlet of creek receiving Randolph E. sewer discharge.
M+13.1		Eagle sewer on the left bank below the Wabasha bridge.
M+13.1	1	Moses sewer on the right bank.
M+13.4		St. Peter sewer on the left bank near the Wabasha bridge.
M+13.8	1-3	In the Mississippi River at the Robert Street bridge, at equal intervals from left to right.
	c	Same as above. Composite of Stations 1, 2, and 3.
M+14.0		Temporary sewer on right bank below the Robert Street bridge.
M+14.4		Trout Brook sewer on left bank below Robert Street bridge.

Mississippi River Survey, from
Coon Rapids Dam to St. Croix River
August & September, 1961

Table 2 (cont'd)

SAMPLING STATIONS

Range	Station	Description
M+16.6	1-3	In the Mississippi River approximately 300 yards above the outfall of the MSSD sewage treatment plant, at equal intervals from left to right.
	c	Same as above. Composite of Stations 1 and 2.
	2d	Same as above at a 12-foot depth below Station 2.
M+17.3	1-3	In the Mississippi River approximately 2 miles above the South St. Paul waste treatment plant, at equal intervals from left to right.
	2d	Same as above at a 10-foot depth below Station 2.
	S	Same as above on the surface at Station 2.
M+19.6		Above submerged sewer outlet off right bank opposite Swift and Company, Inc., in South St. Paul.
M+20.0		Above submerged sewer outfall off right bank opposite Armour and Company, Inc., in South St. Paul.
M+20.8	1-3	In the Mississippi River approximately ½ mile below the South St. Paul waste treatment plant, at equal intervals from left to right.
	2d	Same as above at an 8-foot depth below Station 2.
M+22.7	1-3	In the Mississippi River at the Inver Grove bridge, at equal intervals from left to right.
	2d	Same as above at an 8-foot depth below Station 2.
L+23.0		Outfall of the Northwestern Refining Co. lagoon to the Mississippi River.
M+23.0	1	Outfall of the St. Paul Park sewage treatment plant to the Mississippi River.
M+23.6	1-4	In the Mississippi River approximately 500 yards below the St. Paul Park sewage treatment plant and the Northwestern Refining Co., at equal intervals from left to right.
	2d	Same as above at a 12-foot depth below Station 2.
M+26.5	1-3	In the Mississippi River at Upper Grey Cloud Island above the J. L. Shiely Co. loading dock at equal intervals from left to right.

Mississippi River Survey, from
Coon Rapids Dam to St. Croix River
August & September, 1961

Table 2 (cont'd)

SAMPLING STATIONS

Range	Station	Description
	4	In River Lake adjacent to the sampling range on the river.
	c	Same as above. Composite of Stations 1, 2, and 3.
M+28.2	1	Outfall of the St. Paul Ammonia Products, Inc., to the Mississippi River.
M+28.2	2-5	In the Mississippi River near the St. Paul Ammonia Products, Inc., submerged waste outfall, at equal intervals from left to right.
	c	Same as above. Composite of Stations 2, 3, and 4.
	4d	Same as above at a 12-foot depth below Station 4.
M+28.3	1-4	In the Mississippi River between the St. Paul Ammonia Products, Inc., outfall and the Great Northern Oil Company barge slip, at equal intervals from left to right.
	c	Same as above. Composite at Stations 1, 2, and 3.
	2S	Same as above at the surface of Station 2.
	3d	Same as above at an 8-foot depth below Station 3.
M+28.4	1	At the west end of the Great Northern Oil Company barge slip.
	2	At the center of the Great Northern Oil Company barge slip.
M+29.4	1-7	In the Mississippi River starting at the junction between Upper and Lower Spring Lake to Moore Lake at equal intervals from left to right.
	c_1	Same as above. Composite of Stations 2, 3, and 4.
	c_2	Same as above. Composite of Stations 5 and 6.
	1d	Same as above at a 6-foot depth below Station 1.
M+31.9	1-6	In the Mississippi River immediately below Spring Lake, at equal intervals from left to right.
	c_1	Same as above. Composite of Stations 3, 4, 5, and 6.
	c_2	Same as above. Composite of Stations 1 and 2.

Mississippi River Survey, from
Coon Rapids Dam to St. Croix River
August & September, 1961

Table 2 (cont'd)

SAMPLING STATIONS

Range	Station	Description
M+33.2	1-3	In the Mississippi River approximately 1½ miles above the outlet of the creek which receives the waste from the Minnesota Mining and Manufacturing Company Chemolite Plant, at equal intervals from left to right.
	c	Same as above. Composite of Stations 1, 2, and 3.
	2d	Same as above at a 12-foot depth below Station 2.
M+34.9	1	In the creek below the Minnesota Mining and Manufacturing Company Chemolite Plant settling pond approximately 1,000 feet from the Mississippi River.
M+37.0	1-6	In the Mississippi River above the Hastings dam, at equal intervals from left to right.
	c1	Same as above. Composite of Stations 1, 2, and 3.
	c2	Same as above. Composite of Stations 4, 5, and 6.
	2d	Same as above at a 12-foot depth below Station 2.
M+39.1	1-3	In the Mississippi River at the USH 61 bridge in Hastings, at equal intervals from left to right.
	c	Same as above. Composite of Stations 1, 2, and 3.
	2d	Same as above at a 12-foot depth below Station 2.
M+39.4		Hastings sewage treatment plant effluent.
M+39.6		In the outlet of the Hastings Marina to the Mississippi River on the right side of the river.
M+39.8	1-3	In the Mississippi River approximately 200 feet below the junction with the Vermillion River, at equal intervals from left to right.
	c	Same as above. Composite of Stations 1, 2, and 3.
	2d	Same as above at a 10-foot depth below Station 2.
M+39.8	4	In the Vermillion River approximately 1,000 feet from the Mississippi River.

Mississippi River Survey, from
Coon Rapids Dam to St. Croix River
August & September, 1961

Table 2 (cont'd)

SAMPLING STATIONS

Range	Station	Description
M42.0	1-3	In the Mississippi River approximately 300 yards below the junction with the St. Croix River, at equal intervals from left to right.
	c	Same as above. Composite of Stations 1, 2, and 3.
	2d	Same as above at a 12-foot depth below Station 2.

MINNESOTA DEPARTMENT OF HEALTH
Division of Environmental Sanitation
Section of Water Pollution Control

Mississippi River Survey, 1961

Table 3

COMMUNITIES IN THE METROPOLITAN AREA BORDERING THE MISSISSIPPI RIVER
March, 1962

Community	Population(1)	Sewage Treatment Plant	Individual Systems	Contract for Sewage Disposal
Anoka	10,562	*		
Champlin	1,271		*	
Champlin Township, Hennepin Co.	822		*	
Coon Rapids	14,931		*	
Brooklyn Park	10,197		*	
Fridley	15,173		*	*
Brooklyn Center	24,356			*
Minneapolis	482,872	MSSD		
St. Paul	313,411	MSSD		
Mendota	259		*	
Mendota Heights	5,028		*	
Lilydale	116		*	
South St. Paul	22,032	*		
Newport	2,349		*	
St. Paul Park	3,267	*		
Inver Grove	713		*	
Inver Grove Township, Dakota Co.	5,753		*	
Grey Cloud Island Township, Washington Co.	298		*	
Rosemount Township, Dakota Co.	944		*	
Cottage Grove Township, Washington Co.	4,850	*	*	
Nininger Township, Dakota Co.	332		*	
Hastings	8,965	*		
Denmark Township, Washington Co.	736		*	

(1) 1960 Census Data

MINNESOTA DEPARTMENT OF HEALTH
Division of Environmental Sanitation
Section of Water Pollution Control

Mississippi River Survey, 1961

Table 4

SEWER OUTFALLS TO THE MISSISSIPPI RIVER

Minneapolis(1)

- Columbia Heights Line
- Camden
- 31st Avenue N.E.
- 38th Avenue N.
- 33rd Avenue N.
- 26th Avenue N.
- 21st Avenue N.
- Broadway
- 14th Avenue N.
- Bassetts Creek
- 1st Avenue N.
- 3rd Avenue N.E.
- 8th Avenue S.
- 10th Avenue S.E.
- 11th Avenue S.
- 2nd Street S.
- 4th Street S.
- 5th Street S.
- Oak Street
- 27th Avenue S.E.
- Cecil Street S.E.
- Opening above Mpls. headhouse
- Opening below Mpls. headhouse
- Franklin
- 26th Street
- Bridal Veil Falls
- Lake Street
- 38th Street
- Minnehaha (Large opening)
- Minnehaha (Small opening)

St. Paul(1)

- Eustis Avenue (Somerville)
- Otis Avenue
- Marshall Avenue
- Portland Avenue
- Princeton Avenue
- Jefferson Avenue
- Randolph W.
- Scheffer
- Otto W.
- Davern
- Otto E.
- Randolph E.
- Drake
- Smith

St. Paul (Continued)

- Sherman
- Eagle
- Market
- St. Peter
- Minnesota
- Cedar
- Robert
- Eaton
- Jackson
- Sibley
- Broadway
- Moses
- Custer
- Arthur
- Robie
- State
- Minnetonka
- Trout Brook at 4th St.
- Trout Brook at River
- Urban
- Belt Line

Fridley(2)

- USH 100
- Edge Way
- 62nd Way
- Logan Parkway
- Bellaire

Brooklyn Center(2)

- 71st Avenue N.
- 70th Avenue N.
- 69th Avenue N.
- 65th Avenue N.
- 59th Avenue N.
- 57th Avenue N.
- 56th Avenue N.
- 55th Avenue N.
- 53rd Avenue N.

St. Paul Park(2)

- Broadway
- Eighth Avenue
- Tenth Avenue
- Pullman Avenue

Hastings(2)

- Eddy Street
- Vermillion Street
- Sibley Street
- Tyler Street
- Bailey Street

1. Sewers given the same name as used in the MSSD inspection reports.
2. Storm sewers named for the nearest Street or Avenue. These sewer outfalls are not inspected by MSSD personnel.

Analytical and Field Data

Mississippi River Survey, 1960 and 1961

Section 1

From Rum River in Anoka to the Upper Lock and Dam of St. Anthony Falls, Minneapolis

Table 5

MINNESOTA DEPARTMENT OF HEALTH
Division of Environmental Sanitation
Section of Water Pollution Control

Mississippi River Survey, 1960 and 1961
Table 5

ANALYTICAL AND FIELD DATA

Determinations*	$M\text{-}18.8_1$	$M\text{-}18.8_1$	$M\text{-}18.8_2$	$M\text{-}18.8_2$	$M\text{-}18.8_3$	$M\text{-}18.8_3$
Sample Number	10646	68	10647	67	10648	66
Date Collected	7-26-60	8-11-60	7-26-60	8-11-60	7-26-60	8-11-60
Time Collected	10:30 a.m.	10:25 a.m.	10:40 a.m.	10:20 a.m.	10:50 a.m.	10:15 a.m.
Temperature (°F)	79	74	79	74	78	74
Coliform Group Organisms (MPN/100 ml)	1,100	3,300	2,300	1,100	200	3,300
Dissolved Oxygen	7.1	8.1	7.0	8.0	7.1	8/2

*Results in milligrams per liter except as noted.

Mississippi River Survey, 1960 and 1961

Table 5 (cont'd)

ANALYTICAL AND FIELD DATA

Determinations*	M-18.8c	M-18.8c	M-18.3$_1$	M-18.3$_1$	M-18.3$_2$	M-18.3$_2$
Sample Number	10646	66	10649	69	10650	70
Date Collected	7-26-60	8-11-60	7-26-60	8-11-60	7-26-60	8-11-60
Time Collected			11:10 a.m.	11:10 a.m.	11:20 a.m.	11:05 a.m.
Temperature (°F)			78	74		74
Coliform Group Organisms (MPN/100 ml)			4,900	2,300	1,300	4,600
Total Solids	215	250				
Total Volatile Matter	60	120				
Suspended Solids	10	15				
Suspended Volatile Matter	5	7				
Turbidity	8	8				
pH Value	8.4	8.5	7.2	7.7	7.0	7.9
Dissolved Oxygen						
Biochemical Oxygen Demand, 5 day	2.2	3.3				
Ammonia Nitrogen	0.04	<0.02				
Nitrate Nitrogen		0.1				

***Results are in milligrams per liter except as noted.**
< Means less than.

Mississippi River Survey, 1960 and 1961

Table 5 (cont'd)

ANALYTICAL AND FIELD DATA

Determinations*	M-18.3$_3$	M-18.3$_3$	M-18.3c	M-18.3c	M-17.3$_1$	M-17.3$_2$
Sample Number	10651	71	10649	69	10653	10654
Date Collected	7-26-60	8-11-60	7-26-60	8-11-60	7-26-60	7-26-60
Time Collected	11:30 a.m.	11:00 a.m.			1:05 p.m.	1:05 p.m.
Temperature (°F)		74			79	79
Coliform Group Organisms (MPN/100 ml)	780	4,900			14,000	780
Total Solids			230	270		
Total Volatile Matter			73	130		
Suspended Solids			17	13		
Suspended Volatile Matter			8	8		
Turbidity			10	8		
pH Value			8.4	8.4		
Dissolved Oxygen	7.3	8.1				
Biochemical Oxygen Demand, 5 day			3.5	3.5		
Ammonia Nitrogen			0.08	$<$0.02		
Nitrate Nitrogen				0.08		

*Results are in milligrams per liter except as noted.
$<$ - Means less than.

Mississippi River Survey, 1960 and 1961

Table 5 (cont'd)

ANALYTICAL AND FIELD DATA

Determinations*	M-17.3$_3$	M-13.4$_1$	M-13.4$_2$	M-13.4$_3$	M-13.4c	M-12.9$_1$
Sample Number	10655	10634	10635	10636	10634	6662
Date Collected	7-26-60	7-26-60	7-26-60	7-26-60	7-26-60	9-27-61
Time Collected	1:05 p.m.	1:20 p.m.	1:30 p.m.	1:40 p.m.		2:40 p.m.
Temperature (°F)	79	81	81	81		57
Coliform Group Organisms (MPN/100 ml)	450	7,900	4,900	11,000		2,300
Total Solids					213	
Total Volatile Matter					59	
Suspended Solids					10	
Suspended Volatile Matter					5	
Turbidity					9	
pH Value					8.5	
Dissolved Oxygen		7.6	7.7	8.6		10.5
Biochemical Oxygen Demand, 5 day					1.5	
Ammonia Nitrogen					0.04	

*Results are in milligrams per liter except as noted.

Mississippi River Survey, 1960 and 1961

Table 5 (cont'd)

ANALYTICAL AND FIELD DATA

Determinations*	M-12.9$_2$	M-12.9c	M-9.8	M-9.8$_1$	M-9.8$_1$	M-9.8$_2$
Sample Number	6563	6664	6686	10637	[illegible]	10638
Date Collected	9-27-61	9-27-61	9-28-61	7-26-60	8-30-60	7-26-60
Time Collected	2:45 p.m.		2:00 p.m.	2:20 p.m.	3:10 p.m.	2:30 p.m.
Temperature (°F)	57		59	84	70	
Coliform Group Organisms (MPN/100 ml)	1,300		1,400	7,000		54,000
Total Solids		250	280			
Total Volatile Matter		70	65			
Suspended Solids		20	44			
Suspended Volatile Matter		9	12			
Total Hardness as $CaCO_3$		160	170			
Alkalinity as $CaCO_3$		150	140			
pH Value		8.4	8.3			
Chlorides		2.8	3.2			
Dissolved Oxygen	10.0		11.2	8.4	8.3	8.4
Biochemical Oxygen Demand, 5 day		4.8	5.3			
Phosphorus (total)		0.078	0.082			
Nitrate Nitrogen		0.04	0.04			
Total Nitrogen		0.64	0.74			
Kjeldahl Nitrogen		0.60	0.70			

*Results are in milligrams per liter except as noted.

Mississippi River Survey, 1960 and 1961

Table 5 (cont'd)

ANALYTICAL AND FIELD DATA

Determinations*	$M-9.8_2$	$M-9.8_3$	$M-9.8_3$	M-9.8c	M-9.8c	$M-7.7_1$
Sample Number	510	10639	511	10637	509	6525
Date Collected	8-30-60	7-26-60	8-30-60	7-26-60	8-30-60	9-26-61
Time Collected	3:15 p.m.	2:40 p.m.	3:20 p.m.			3:10 p.m.
Temperature (^{o}F)	70	84	70			60
Coliform Group Organisms (MPN/100 ml)		7,000				1,700
Total Solids				230	220	
Total Volatile Matter				72	88	
Suspended Solids				13	17	
Suspended Volatile Matter				6	6	
Turbidity				11	7	
pH Value				8.5	7.7	
Dissolved Oxygen	8.8	8.5	8.9			11.6
Biochemical Oxygen Demand, 5 day				2.8	2.4	
Ammonia Nitrogen				NF	NF	

*Results are in milligrams per liter except as noted.
NF- Means none found.

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Mississippi River Survey, 1960 and 1961

Table 5 (cont'd)

ANALYTICAL AND FIELD DATA

Determinations*	$M-7.7_2$	$M-7.7_3$	M-7.7c	M-6.2[illegible]	$M-6.2_1$	M-6.2[illegible]
Sample Number	6524	6527	6526	10640	80	10641
Date Collected	9-26-61	9-26-61	9-26-61	7-26-[illegible]	8-11-60	7-26-60
Time Collected	3:00 p.m.	4:00 p.m.	3:30 p.m.	3:25 p.m.	3:15 p.m.	3:30 p.m.
Temperature (°F)	60			84	77	
Coliform Group Organisms (MPN/100 ml)	1,300	1,700		1,300	450	1,100
Total Solids		260	240			
Total Volatile Matter		75	80			
Suspended Solids		22	17			
Suspended Volatile Matter		10	8			
Total Hardness as $CaCO_3$		170	170			
Alkalinity as $CaCO_3$		140	150			
pH Value		8.3	8.3			
Chlorides		2.0	2.5			
Dissolved Oxygen	11.5	11.8		9.0	10.1	8.9
Biochemical Oxygen Demand, 5 day		5.0	5.0			
Phosphorus (total)		0.064	0.056			
Nitrate Nitrogen		0.26	0.26			
Total Nitrogen		0.76	0.82			
Kjeldahl Nitrogen		0.50	0.56			

*Results are in milligrams per liter except as noted.

Mississippi River Survey, 1960 and 1961

Table 5 (cont'd)

ANALYTICAL AND FIELD DATA

Determinations	M-6.2$_2$	M-6.2$_3$	M-6.2$_3$	M-6.2c	M-6.2c	M-6.2$_1$
Sample Number	81	10642	82	10640	80	6444
Date Collected	8-11-60	7-26-60	8-11-60	7-26-60	8-11-60	9-21-61
Time Collected	3:20 p.m.	3:35 p.m.	3:25 p.m.			12:50 p.m.
Temperature (°F)	77		78			65
Coliform Group Organisms (MPN/100 ml)	< 200	1,300	< 200			1,300
Total Solids				248	250	
Total Volatile Matter				80	84	
Suspended Solids				22	15	
Suspended Volatile Matter				9	7.2	
Turbidity				9	10	
pH Value				8.4	8.4	
Dissolved Oxygen	9.2	9.0	10.3			9.5
Biochemical Oxygen Demand, 5 day				4.8	3.5	
Ammonia Nitrogen				0.02	<0.02	
Nitrate Nitrogen					0.16	

*Results are in milligrams per liter except as noted.
< - Means less than.

Mississippi River Survey, 1960 and 1961

Table 5 (cont'd)

ANALYTICAL AND FIELD DATA

Determinations*	M-6.2$_2$	M-6.2$_3$	M-6.2c	M-6.2$_{2d}$	M-4.9	M-2.3
Sample Number	6445	6446	6447	6448	6449	6450
Date Collected	9-21-61	9-21-61	9-21-61	9-21-61	9-21-61	9-21-61
Time Collected	1:00 p.m.	1:10 p.m.		1:30 p.m.	2:00 p.m.	2:30 p.m.
Temperature (°F)	65	66				
Coliform Group Organisms (MPN/100 ml)	2,300	780		1,300	200	1,100
Total Solids			250		580	430
Total Volatile Matter			68		160	110
Suspended Solids			24		380	3
Suspended Volatile Matter			11		97	1
Total Hardness as $CaCO_3$			170		64	360
Alkalinity as $CaCO_3$			150		350	280
pH Value			8.5		8.4	7.6
Chlorides			1.9		2.8	6.4
Dissolved Oxygen	10.0	10.0				
Biochemical Oxygen Demand, 5 day			5.8		17	1.8
Phosphorus			0.10		0.38	0.32
Nitrate Nitrogen			<0.02		<0.02	0.16
Nitrite Nitrogen						<0.01
Total Nitrogen			0.56		3.3	0.38
Kjeldahl Nitrogen			0.56		3.3	0.22
Estimated Flow (gpm)					600-800	100

*Results are in milligrams per liter except as noted.
< - Means less than.

Mississippi River Survey, 1960 and 1961

Table 5 (cont'd)

ANALYTICAL AND FIELD DATA

Determinations*	$M\text{-}2.2_1$	$M\text{-}2.2_2$	$M\text{-}2.2_3$	M-2.2c	$M\text{-}2.2_{2d}$	$M\text{-}1.7_1$
Sample Number	6439	6440	6441	6442	6443	6413
Date Collected	9-21-61	9-21-61	9-21-61	9-21-61	9-21-61	9-20-61
Time Collected	9:50 a.m.	9:55 a.m.	10:00 a.m.		11:00 a.m.	
Temperature (°F)	63	63	62			64
Coliform Group Organisms (MPN/100 ml)	7,000	1,300	1,700		3,300	1,100
Total Solids				310		
Total Volatile Matter				90		
Suspended Solids				74		
Suspended Volatile Matter				14		
Total Hardness as $CaCO_3$				180		
Alkalinity as $CaCO_3$				160		
pH Value				8.5		
Chlorides				2.2		
Dissolved Oxygen	7.5	8.5	8.1			8.0
Biochemical Oxygen Demand, 5 day				4.2		
Phosphorus				0.18		
Nitrate Nitrogen				$<$0.02		
Total Nitrogen				0.58		
Kjeldahl Nitrogen				0.58		

*Results are in milligrams per liter except as noted.
$<$ - Means less than.

Mississippi River Survey, 1960 and 1961

Table 5 (cont'd)

ANALYTICAL AND FIELD DATA

Determinations*	$M\text{-}1.7_2$	$M\text{-}1.7_3$	M-1.7c	$M\text{-}1.7_{2d}$	M-1.5
Sample Number	6412	6411	6414	6416	6415
Date Collected	9-20-61	9-20-61	9-20-61	9-20-61	9-20-61
Time Collected			3:00 p.m.	2:50 p.m.	3:20 p.m.
Temperature (°F)	65	64		64	62
Coliform Group Organisms (MPN/100 ml)	4,900	1,400		780	20
Total Solids			280		410
Total Volatile Matter			73		110
Suspended Solids			6		76
Suspended Volatile Matter			1		0
Total Hardness as $CaCO_3$			170		360
pH Value			8.7		7.9 (oily)
Chlorides			2.1		5.4
Sulphates			23		54
Dissolved Oxygen	8.3	8.0			
Biochemical Oxygen Demand, 5 day			5.8		4.5
Phosphorus			0.12		0.044
Nitrate Nitrogen			<.02		<.02
Total Nitrogen			0.8		0.14
Kjeldahl Nitrogen			0.8		0.14
Oil					125.0
Estimated Flow (gpm)					300

*Results are in milligrams per liter except as noted.
< - Means less than.

Analytical and Field Data
Mississippi River Survey, 1961

Section 2

From Upper Lock and Dam of St. Anthony Falls to the Outfall of the Minneapolis-St. Paul Sanitary District Sewage Treatment Plant in St. Paul

Table 6

MINNESOTA DEPARTMENT OF HEALTH
Division of Environmental Sanitation
Section of Water Pollution Control

Mississippi River Survey, 1961
Table 6

ANALYTICAL AND FIELD DATA

Determinations*	M-0.1	M+0.1	M+0.1$_1$	M+0.4$_1$	M+0.4$_2$	M+0.4C
Sample Number	6404	6402	6403	6400	6399	6400
Date Collected	9-20-61	9-20-61	9-20-61	9-20-61	9-20-61	9-20-61
Time Collected	12:00 N	11:45 a.m.	11:46 a.m.	11:10 a.m.	11:00 a.m.	11:10 a.m.
Temperature (°F)	70	85	66		65	
Coliform Group Organisms (MPN/100 ml)	3,100		7,000	4,500	13,000	
Total Solids	440	300	610			250
Total Volatile Matter	100	72	40			65
Suspended Solids	53	62	46			84
Suspended Volatile Matter	22	10	8			20
Total Hardness as $CaCO_3$	330	180	70			180
Alkalinity as $CaCO_3$	230	170	54			160
Chlorides	5.6	3.6	2.8			2.5
Sulphates	81	26	40			20
Dissolved Oxygen						8.5
Biochemical Oxygen) 5-Day Demand	5.0	7.3	3.0			
Phosphorus						0.11
Nitrate Nitrogen	1.2	<0.02	<0.02			0.02
Total Nitrogen	1.6	0.56	1.0			0.58
Kjeldahl Nitrogen	0.42	0.56	1.0			0.56
Estimated Flow (gpm)	1500-1700	300-500	100-150			

*Results are in milligrams per liter except as noted.
<Means less than.
>Means greater than.

Mississippi River Survey, 1961

Table 6 (cont'd)

ANALYTICAL AND FIELD DATA

Determinations*	M+0.4$_{2d}$	M+0.6	M+1.5	M+1.5$_1$	M+1.5$_2$	M+3.1$_1$
Sample Number	6401	6398	6386	6385	6384	6381
Date Collected	9-20-61	9-20-61	9-19-61	9-19-61	9-19-61	9-19-61
Time Collected	11:15 a.m.		3:20 p.m.	3:10 p.m.	3:00 p.m.	2:10 p.m.
Temperature (^oF)		54	56			65
Coliform Group Organisms (MPN/100 ml)	2,000	170,000	780			1,700
Total Solids		580	460			
Total Volatile Matter		140	100			
Suspended Solids		41	63			
Suspended Volatile Matter		40	10			
Total Hardness as $CaCO_3$		430	380			
Alkalinity as $CaCO_3$		260	280			
pH Value			7.5			9.0
Chlorides		11	8.0			
Sulphates		120				
Dissolved Oxygen				10.0	10.3	10.5
Biochemical Oxygen) 5-Day Demand		5.7	3.8			
Phosphorus		0.73	0.23			
Nitrate Nitrogen		1.9	0.06			
Total Nitrogen		4.2	0.24			
Kjeldahl Nitrogen		2.3	0.18			
Estimated Flow (gpm)		1600	2000			

*Results are in milligrams per liter except as noted.

Mississippi River Survey, 1961

Table 6 (cont'd)

ANALYTICAL AND FIELD DATA

Determinations*	M+3.1$_2$	M+3.1C	M+3.1$_{1d}$	M+3.2	M+3.8	M+4.1
Sample Number	6380	6380	6382	6383	6379	6378
Date Collected	9-19-61	9-19-61	9-19-61	9-19-61	9-19-61	9-19-61
Time Collected	2:00 p.m.		2:15 p.m.	2:45 p.m.	12:45 p.m.	12:30 p.m.
Temperature (°F)	64	64		59	68	65
Coliform Group Organisms (MPN/100 ml)	4,900		3,300	20,000	>24,000,000	16,000,000
Total Solids		250		640	640	330
Total Volatile Matter		75		150	260	100
Suspended Solids		34		12	20	58
Suspended Volatile Matter		8		8	13	5
Total Hardness as $CaCO_3$		180		440	160	
Alkalinity as $CaCO_3$		160		220	200	
pH Value		8.9		8.4	7.6	8.1
Chlorides		2.5		15	27	9.0
Dissolved Oxygen	12.1					
Biochemical Oxygen)5-Day Demand		7.5		4.3	150	22
Phosphorus		0.35		0.14	4.1	0.16
Nitrate Nitrogen		<0.02		<0.02		
Total Nitrogen		0.7		0.48	13	0.25
Kjeldahl Nitrogen		0.7		0.48	13	0.25
Estimated Flow (gpm)					300	**

*Results are in milligrams per liter except as noted.
**Partially Submerged.
<Means less than.
>Means greater than.

Mississippi River Survey, 1961

Table 6 (cont'd)

ANALYTICAL AND FIELD DATA

Determinations*	M+4.6	M+5.2	M+5.4_1	M+5.4_2	M+5.4_3	M+5.4C
Sample Number	6377	6376	6375	6374	6373	6373
Date Collected	9-19-61	9-19-61	9-19-61	9-19-61	9-19-61	9-19-61
Time Collected	12:00 N	11:30 a.m.	9:50 a.m.	10:10 a.m.	10:10 a.m.	
Temperature (°F)	68	62	63	63	63	63
Coliform Group Organisms (MPN/100 ml)	>24,000,000	5,400,000	22,000	3,300	11,000	
Total Solids	670	350				240
Total Volatile Matter	250	82				70
Suspended Solids	31	78				28
Suspended Volatile Matter	7	46				9
Total Hardness as $CaCO_3$	170	260				180
Alkalinity as $CaCO_3$	210	260				160
pH Value	7.8	8.7	9.1	9.4		9.4
Chlorides	18	2.8				2.0
Dissolved Oxygen			10.9	9.6	11.7	
Biochemical Oxygen)5-Day Demand	183	25				7.5
Phosphorus	4.2	0.14				0.18
Nitrate Nitrogen						<0.02
Total Nitrogen	14	0.21				0.64
Kjeldahl Nitrogen	14	0.21				0.64
Estimated Flow (gpm)	300	1200				

*Results are in milligrams per liter except as noted.
<Means less than.
>Means greater than.

Mississippi River Survey, 1961

Table 6 (cont'd)

ANALYTICAL AND FIELD DATA

Determinations*	M+5.6	M+5.8	$M+6.0_1$	$M+6.0_2$	M+6.0C	$M+6.0_{2d}$
Sample Number	6340	6335	6337	6336	6338	6339
Date Collected	9-18-61	9-18-61	9-18-61	9-18-61	9-18-61	9-18-61
Time Collected	2:30 p.m.	1:55 p.m.	2:05 p.m.	2:00 p.m.		
Temperature (°F)	76		63	64		
Coliform Group Organisms (MPN/100 ml)		> 24,000,000	7900	240,000		22,000
Total Solids	240	520			260	
Total Volatile Matter	80	210			80	
Suspended Solids	36	100			33	
Suspended Volatile Matter	10	90			11	
Total Hardness as $CaCO_3$	110	320			200	
Alkalinity as $CaCO_3$	120	220			160	
pH Value	8.2	7.4			8.3	
Chlorides	2.8	10			2.3	
Dissolved Oxygen			10.5	10.5		
Biochemical Oxygen)5-Day Demand	11	128			3.5	
Phosphorus	0.16	3.0			0.15	
Nitrate Nitrogen					0.02	
Total Nitrogen	0.96	8.2			0.78	
Kjeldahl Nitrogen	0.96	8.2			0.76	
Estimated Flow (gpm)	100-150	150-200				

*Results are in milligrams per liter except as noted.
> Means greater than.

Mississippi River Survey, 1961

Table 6 (cont'd)

ANALYTICAL AND FIELD DATA

Determinations*	M+7.5$_1$	M+7.5$_2$	M+7.5$_3$	M+7.5C	M+7.5$_{2d}$	M+7.9
Sample Number	6334	6343	6342	6345	6346	6341
Date Collected	9-18-61	9-18-61	9-18-61	9-18-61	9-18-61	9-18-61
Time Collected	12:40 p.m.	12:30 p.m.	12:25 p.m.		1:20 p.m.	11:30 a.m.
Temperature (°F)	63	63	64			
Coliform Group Organisms (MPN/100 ml)	24,000	17,000	22,000		17,000	5,400,000
Total Solids				270		450
Total Volatile Matter				90		130
Suspended Solids				32		180
Suspended Volatile Matter				12		110
Total Hardness as $CaCO_3$				180		300
Alkalinity as $CaCO_3$				160		270
pH Value				8.1		7.6
Chlorides				2.0		3.4
Dissolved Oxygen	10.3		11.0			
Biochemical Oxygen)5-Day Demand				1		29
Phosphorus				0.14		2.8
Nitrate Nitrogen				<0.02		
Total Nitrogen				0.76		2.2
Kjeldahl Nitrogen				0.76		2.2

*Results are in milligrams per liter except as noted.
<Means less than.

Mississippi River Survey, 1961

Table 6 (cont'd)

ANALYTICAL AND FIELD DATA

Determinations*	M+8.0	$M+9.1_1$	$M+9.1_2$	$M+9.1_3$	M+9.1C	$M+9.1_{2d}$
Sample Number	6352	6347	6348	6349	6350	6351
Date Collected	9-18-61	9-18-61	9-18-61	9-18-61	9-18-61	9-18-61
Time Collected		10:10 a.m.	10:15 a.m.	10:20 a.m.		
Temperature (°F)		63	64			
Coliform Group Organisms (MPN/100 ml)	17,000	17,000	22,000	17,000		35,000
Total Solids					410	
Total Volatile Matter					100	
Suspended Solids					49	
Suspended Volatile Matter					12	
Total Hardness as $CaCO_3$					270	
Alkalinity as $CaCO_3$					210	
pH Value					8.0	
Chlorides					4.0	
Dissolved Oxygen		9.5	8.6	8.1		
Biochemical Oxygen) 5-Day Demand					7**	
Phosphorus					0.17	
Nitrate Nitrogen					<0.02	
Total Nitrogen					0.98	
Kjeldahl Nitrogen					0.98	

*Results are in milligrams per liter except as noted.
**Estimated value after partial incubation.
< Means less than.

Mississippi River Survey, 1961

Table 6 (cont'd)

ANALYTICAL AND FIELD DATA

Determinations*	M+11.6	M+13.1	M+13.1$_1$	M+13.4	M+13.8$_1$	M+13.8$_2$
Sample Number	6353	6316	6317	6315	6312	6311
Date Collected	9-18-61	9-15-61	9-15-61	9-15-61	9-15-61	9-15-61
Time Collected	3:00 p.m.	12:05 p.m.	12:20 p.m.	12:00 N	11:50 a.m.	11:40 a.m.
Coliform Group Organisms (MPN/100 ml)	26,000	1,100,000	780	490,000	45,000	45,000
Dissolved Oxygen					5.2	5.6
Estimated Flow (gpm)		200-300	50-100	100		

*Results are in milligrams per liter except as noted.

Mississippi River Survey, 1961

Table 6 (cont'd)

ANALYTICAL AND FIELD DATA

Determinations*	$M+13.8_3$	M+13.8C	M+14.0	M+14.4	$M+16.6_1$	$M+16.6_2$
Sample Number	6310	6313	6318	6314	6306	6205
Date Collected	9-15-61	9-15-61	9-15-61	9-15-61	9-15-61	9-15-61
Time Collected	11:30 a.m.		11:20 a.m.		9:50 a.m.	9:40 a.m.
Temperature (°F)		63			69	69
Coliform Group Organisms (MPN/100 ml)	45,000		45	2,400,000	7,900	45,000
Total Solids		430		450	370	
Total Volatile Matter		110		120	90	
Suspended Solids		50		63	65	
Suspended Volatile Matter		14		21	13	
Total Hardness as $CaCO_3$		270		280	250	
Alkalinity as $CaCO_3$		210		210	190	
pH Value		7.6		7.8	7.7	
Chlorides		8		5	5	
Dissolved Oxygen	5.6				5.0	4.9
Biochemical Oxygen) 5-Day Demand		3.3		18	2.5	
Phosphorus		0.18		0.47	0.19	
Nitrate Nitrogen		0.08		0.12	0.04	
Total Nitrogen		0.84		1.3	0.94	
Kjeldahl Nitrogen		0.76		1.2	0.90	
Estimated Flow (gpm)			600-700			

*Results are in milligrams per liter except as noted.

Mississippi River Survey, 1961

Table 6 (cont'd)

ANALYTICAL AND FIELD DATA

Determinations*	$M+16.6_3$	M+16.6C	$M+16.6_{2d}$
Sample Number	6304	6307	6308
Date Collected	9-15-61	9-15-61	9-15-61
Time Collected	9:30 a.m.		
Temperature (°F)	68		
Coliform Group Organisms (MPN/100 ml)	20,000		24,000
Total Solids		420	
Total Volatile Matter		110	
Suspended Solids		66	
Suspended Volatile Matter		18	
Total Hardness as $CaCO_3$		250	
Alkalinity as $CaCO_3$		190	
pH Value		7.5	
Chlorides		4.3	
Biochemical Oxygen)5-Day Demand		5.5	
Dissolved Oxygen	5.6		
Phosphorus		0.19	
Nitrate Nitrogen		0.04	
Total Nitrogen		0.98	
Kjeldahl Nitrogen		0.94	

*Results are in milligrams per liter except as noted.

Analytical and Field Data

Mississippi River Survey, 1961

Section 3

From the Outfall of the
Minneapolis-St. Paul Sanitary District
Sewage Treatment Plant in St. Paul to the
Junction with the St. Croix River, Below Hastings

Table 7

MINNESOTA DEPARTMENT OF HEALTH
Division of Environmental Sanitation
Section of Water Pollution Control

Mississippi River Survey, 1961

Table 7

ANALYTICAL AND FIELD DATA

Determinations*	M+17.3$_1$	M+17.3$_2$	M+17.3$_3$	M+17.3$_{2d}$	M+17.3$_5$	M+19.6	M+20.0
Sample Number	6295	6294	6293	6296	6297	6298	6309
Date Collected	9-14-61	9-14-61	9-14-61	9-14-61	9-14-61	9-14-61	9-15-61
Time Collected	1:40 p.m.	1:30 p.m.	1:20 p.m.				11:00 a.m.
Temperature (^oF)	69	69	68			69	
Coliform Group Organisms (MPN/100 ml)	>24,000,000	5,400,000	490,000	9,200,000			
Total Solids	870	490	510			1,400	880
Total Volatile Matter	430	220	190			700	180
Suspended Solids	52	50	53			230	100
Suspended Volatile Matter	20	14	12			180	40
Total Hardness as $CaCO_3$							260
Alkalinity as $CaCO_3$	190	190	190			240	280
pH Value	7.4	7.6	7.9			7.3	
Chlorides	6					40	80
Dissolved Oxygen	2.8	4.0	4.9	4.5			
Biochemical Oxygen Demand, 5-day	14	5.3	1			30	55
Phosphorus (total)	0.64	0.51	0.34			2.7	
Ammonia Nitrogen	0.54	0.16	0.16				
Organic Nitrogen	1.4	0.84	0.74				
Nitrite Nitrogen	<0.02	<0.02	0.01				2.1
Nitrate Nitrogen	0.08	0.08	0.04				
Total Nitrogen		0.016	0.039			7.1	
Kjeldahl Nitrogen						7.1	1.4

*Results are in milligrams per liter except as noted.
> - Means greater than.
< - Means less than.

Mississippi River Survey, 1961

Table 7 (cont'd)

ANALYTICAL AND FIELD DATA

Determinations*	M+20.8$_1$	M+20.8$_2$	M+20.8$_3$	M+20.8$_{2d}$	M+22.7$_1$	M+22.7$_2$	M+22.7$_3$
Sample Number	6291	6290	6289	6292	6279	6278	6277
Date Collected	9-14-61	9-14-61	9-14-61	9-14-61	9-13-61	9-13-61	9-13-61
Time Collected	10:50 a.m.	10:40 a.m.	10:30 a.m.	11:15 a.m.	2:10 p.m.	2:00 p.m.	1:45 p.m.
Temperature (°F)		68	68		70	69	69
Coliform Group Organisms (MPN/100 ml)	>24,000,000	>24,000,000	>24,000,000	9,200,00	16,000,000	>24,000,000	>24,000,000
Total Solids	640	510	460		380	390	390
Total Volatile Matter	310	250	160		100	120	110
Suspended Solids	25	28	28		32	31	26
Suspended Volatile Matter	13	14	21		15	16	14
Total Hardness as $CaCO_3$					230	230	230
Alkalinity as $CaCO_3$	200		200		180	180	190
pH Value	7.4		7.3		7.3	7.3	7.4
Chlorides	7		11		7	9	11
Dissolved Oxygen	0	0	0		0.0	0.0	0.0
Biochemical Oxygen Demand, 5-day	11	7	11		14	14	14
Phosphorus (total)	0.57	0.58	0.80		0.43	0.45	0.40
Ammonia Nitrogen	0.76	0.64	1.1				
Organic Nitrogen	1.4	1.4	1.3				
Nitrite Nitrogen	<0.02	<0.02	<0.02				
Nitrate Nitrogen	0.06	0.02	0.04		0.1		0.02
Total Nitrogen	0.066	0.064	0.061				
Kjeldahl Nitrogen					1.9	1.9	1.9
Phenol					0.046	0.046	0.044

*Results are in milligrams per liter except as noted.

> - Means greater than.

< - Means less than.

Mississippi River Survey, 1961

Table 7 (cont'd)

ANALYTICAL AND FIELD DATA

Determinations*	$M+22.7_{2d}$	M+23.0	$M+23.0_1$	$M+23.6_1$	$M+23.6_2$	$M+23.6_3$	$M+23.6_4$
Sample Number	6280	6275	6276	6273	6272	6271	6259
Date Collected	9-13-61	9-13-61	9-13-61	9-13-61	9-13-61	9-13-61	9-12-61
Time Collected	2:45 p.m.			11:20 a.m.	11:10 a.m.	11:00 a.m.	2:15 p.m.
Temperature (°F)				70	70	70	70
Coliform Group Organisms (MPN/100 ml)	9,200,000			> 24,000,000	> 24,000,000	> 24,000,000	5,400,000
Total Solids		460	730	410	380	390	440
Total Volatile Matter		90	200	110	80	90	120
Suspended Solids		12	110	31	29	28	63
Suspended Volatile Matter		6	70	12	14	16	18
Turbidity							35
Total Hardness as $CaCO_3$		210	260	250	240	260	480
Alkalinity as $CaCO_3$		210	420	180	190	170	196
pH Value		8.4	7.5		7.5	7.5	7.4
Chlorides		9	45	7	34	29	32
Dissolved Oxygen	0.0**			0.0	0.0	0.0	0.9
Biochemical Oxygen Demand, 5-day		25	78	9.8	10	10	5.8
Phosphorus (total)		0.45	6.0	0.34	0.51	0.56	0.58
Nitrite Nitrogen			< 0.02				
Nitrate Nitrogen		0.1	0.12	0.08	0.08	0.12	0.12
Total Nitrogen							1.9
Kjeldahl Nitrogen		5.8	31	1.7	1.0	1.8	1.8
Phenol				0.049	0.037	0.03	
Surfactant, ABS			10.6	0.3	0.32	0.29	

*Results are in milligrams per liter except as noted.
**Dissolved oxygen sample collected at surface.
> - Means greater than.
< - Means less than.

Mississippi River Survey, 1961

Table 7 (cont'd)

ANALYTICAL AND FIELD DATA

Determinations*	$M+23.6_{2d}$	$M+26.5_1$	$M+26.5_2$	$M+26.5_3$	$M+26.5_4$	M+26.5c	$M+28.2_1$
Sample Number	6274	6212	6211	6210	6213	6214	6120
Date Collected	9-13-61	9-11-61	9-11-61	9-11-61	9-11-61	9-11-61	9-6-61
Time Collected	12:00 N	1:50 p.m.	1:45 p.m.	1:35 p.m.	2:45 p.m.		1:00 p.m.
Temperature (^oF)		75	75	77	71		
Coliform Group Organisms (MPN/100 ml)	16,000,000	5,400,000	3,500,000	9,200,000	330,000		
Total Solids					420	370	
Total Volatile Matter					120	100	
Suspended Solids					78	20	
Suspended Volatile Matter					33	10	
Turbidity					37	20	20
Total Hardness as $CaCO_3$					230	240	
Alkalinity as $CaCO_3$					170	200	
pH Value		8.4	8.4	8.4	8.6		
Chlorides					6.3	5.6	
Fluorides					<0.1	0.16	0.22
Dissolved Oxygen		0.0	0.0	0.0	9.9		
Biochemical Oxygen Demand, 5-day					14	7.7	10
Phosphorus (total)					0.5	0.61	0.74
Ammonia Nitrogen					0.1	0.96	4.04
Organic Nitrogen					2.1	1.1	1.52
Nitrite Nitrogen					<0.02	<0.02	0.99
Nitrate Nitrogen					0.1	0.08	5.0
Total Nitrogen							11.6
Phenol					<0.005	<0.005	0.024

*Results are in milligrams per liter except as noted.
>- Means greater than.
<- Means less than.

Mississippi River Survey, 1961

Table 7 (cont'd)

ANALYTICAL AND FIELD DATA

Determinations*	M+28.2_2	M+28.2_3	M+28.2_4	M+28.2_5	M+28.2c	M+28.2_{4d}	M+28.3_1
Sample Number	6218	6217	6216	6215	6220	6219	6042
Date Collected	9-11-61	9-11-61	9-11-61	9-11-61	9-11-61	9-11-61	8-31-61
Time Collected				12:15 p.m.		12:35 p.m.	1:00 p.m.
Temperature (°F)	75	75	75	75			80
Coliform Group Organisms (MPN/100 ml)	1,300,000	3,500,000	1,700,000	1,300,000		2,400,000	920,000
Total Solids				380	380		
Total Volatile Matter				130	120		
Suspended Solids				19	26		
Suspended Volatile Matter				11	13		
Turbidity				28	13		
Total Hardness as $CaCO_3$				240	240		
Alkalinity as $CaCO_3$				180	18		
pH Value	8.3	8.3	8.3	8.3	7.3		7.3
Chlorides				5.6	5.6		
Fluorides					0.11		
Dissolved Oxygen	0.0	0.0	0.0	0.9		0.1**	0.7
Biochemical Oxygen Demand, 5-day				10	13		
Phosphorus (total)				0.46	0.43		
Ammonia Nitrogen				1.4	1.0		
Organic Nitrogen				1.7	1.2		
Nitrite Nitrogen				0.07	<0.02		
Nitrate Nitrogen				0.3	0.08		
Phenol				<0.05	<0.05		

*Results are in milligrams per liter except as noted.

**Dissolved oxygen samples collected at approximately one foot depth.

> - Means greater than.

< - Means less than.

Mississippi River Survey, 1961

Table 7 (cont'd)

ANALYTICAL AND FIELD DATA

Determinations*	$M+28.3_2$	$M+28.3_3$	$M+28.3_4$	M+28.3c	$M+23.3_{30}$	$M+28.3_{25}$	$M+28.4_1$
Sample Number	6040	6039	6038	6043	6044	6041	6037
Date Collected	8-31-61	8-31-61	8-31-61	8-31-61	8-31-61	8-31-61	8-31-61
Time Collected	12:50 p.m.	12:40 p.m.	12:30 p.m.		1:10 p.m.	12:55 p.m.	11:30 a.m.
Temperature (°F)	79	79	79		79	79	79
Coliform Group Organisms (MPN/100 ml)	1,700,000	540,000	2,400,000		5,400,000		240,000
Total Solids			460	430			440
Total Volatile Matter			180	170			130
Suspended Solids			20	26			17
Suspended Volatile Matter			10	13			10
Total Hardness as $CaCO_3$			260	270			270
Alkalinity as $CaCO_3$			220	220			210
pH Value	7.3	7.3	7.3				7.6
Chlorides			28	28			25
Fluorides			0.22	0.22			0.22
Dissolved Oxygen	0	0	0			0	0.6
Biochemical Oxygen Demand, 5-day			7.8	10			7.4
Phosphorus (total)			0.63	0.70			0.56
Ammonia Nitrogen			1.3	1.0			1.2
Organic Nitrogen			1.4	1.7			1.1
Nitrite Nitrogen			<0.02	<0.02			<0.02
Nitrate Nitrogen			1.5	1.4			1.4
Total Nitrogen			4.2	4.1			3.7
Phenol			0.014	<0.005			

*Results are in milligrams per liter except as noted.
>- Means greater than.
<- Means less than.

Mississippi River Survey, 1961

Table 7 (cont'd)

ANALYTICAL AND FIELD DATA

Determinations*	M+28.4$_2$	M+29.4$_1$	M+29.4$_2$	M+29.4$_3$	M+29.4$_4$	M+29.4$_5$	M+29.4$_6$
Sample Number	6045	6026	6028	6029	6030	6032	6033
Date Collected	8-31-61	8-30-61	8-30-61	8-30-61	8-30-61	8-30-61	8-30-61
Time Collected	11:45 a.m.	12:45 p.m.	2:00 p.m.	1:45 p.m.	1:30 p.m.	2:45 p.m.	3:00 p.m.
Temperature (°F)	79	76	79	79	79	77	78
Coliform Group Organisms	1,700,000	1,300	54,000	24,000	35,000	920,000	920,000
Total Solids		350					
Total Volatile Matter		140					
Suspended Solids		22					
Suspended Volatile Matter		10					
Total Hardness as $CaCO_3$		220					
Alkalinity as $CaCO_3$		150					
pH Value		7.7		7.6	7.7	7.2	
Chlorides		14					
Fluorides		0.12					
Dissolved Oxygen		3.8	5.2	6.9	6.9	0.7	1.2
Biochemical Oxygen Demand, 5-day		8.2					
Phosphorus		0.50					
Ammonia Nitrogen		0.50					
Organic Nitrogen		1.1					
Nitrite Nitrogen		< 0.02					
Nitrate Nitrogen		2.1					
Total Nitrogen		3.7					
Phenol		0.005					

*Results are in milligrams per liter except as noted.

> - Means greater than.

< - Means less than.

Mississippi River Survey, 1961

Table 7 (cont'd)

ANALYTICAL AND FIELD DATA

Determinations*	$M+29.4_7$	$M+29.4c_1$	$M+29.4c_2$	$M+29.4_{1d}$	$M+31.9_1$	$M+31.9_2$	$M+31.9_3$
Sample Number	6035	6031	6034	6027	6015	6012	6010
Date Collected	8-30-61	8-30-61	8-30-61	8-30-61	8-29-61	8-29-61	8-29-61
Time Collected	3:15 p.m.	1:30 p.m.		12:45 p.m.	1:39 p.m.		1:35 p.m.
Temperature (°F)	73				78	78	78
Coliform Group Organisms (MPN/100 ml)	1,600,000			780	240,000	11,000	1,100,000
Total Solids	440	500	480				
Total Volatile Matter	140	140	150				
Suspended Solids	18	62	44				
Suspended Volatile Matter	8	19	13				
Total Hardness as $CaCO_3$	300	300	250				
Alkalinity as $CaCO_3$	210	220	210				
pH Value	7.3	7.9	7.2		7.8	7.8	7.4
Chlorides	20	23	20				
Fluorides	0.16	0.18	0.22				
Dissolved Oxygen	0.7				9.4	10.9	2.4
Biochemical Oxygen Demand, 5-day	6.8	12	9.0				
Phosphorus (total)	0.56	0.68	0.60				
Ammonia Nitrogen	0.98	.68	0.98				
Organic Nitrogen	0.74	1.5	1.2				
Nitrite Nitrogen	<0.02	<0.02	<0.02				
Nitrate Nitrogen	1.3	1.4	1.4				
Total Nitrogen	3.0	3.6	3.6				
Phenol	<0.005	<0.005	<0.005				

*Results are in milligrams per liter except as noted.

> - Means greater than.

< - Means less than.

Mississippi River Survey, 1961

Table 7 (cont'd)

ANALYTICAL AND FIELD DATA

Determinations*	$M+31.9_4$	$M+31.9_5$	$M+31.9_6$	$M+31.9c_1$	$M+31.9c_2$	$M+31.9_{5d}$	$M+33.2_1$
Sample Number	6009	6008	6007	6011	6013	6014	5966
Date Collected	8-29-61	8-29-61	8-29-61	8-29-61	8-29-61	8-29-51	8-25-61
Time Collected	1:34 p.m.	1:32 p.m.	1:30 p.m.		1:39 p.m.	3:00 p.m.	10:50 a.m.
Temperature (°F)	77	76	77		78	78	73
Coliform Group Organisms (MPN/100 ml)	1,600,000	920,000	240,000			700,000	230,000
Total Solids				450	430		
Total Volatile Matter				160	150		
Suspended Solids				26	32		
Suspended Volatile Matter				14	16		
Total Hardness as $CaCO_3$				290	250		
Alkalinity as $CaCO_3$				220	210		
pH Value	7.2	7.2	7.6				7.7
Chlorides				40	25		
Fluorides				0.90	0.46		
Dissolved Oxygen	1.1	0	5.0				4.4
Biochemical Oxygen Demand, 5-day				9.4	12		
Phosphorus (total)				0.58	0.46		
Ammonia Nitrogen				0.84	0.60		
Organic Nitrogen				1.5	1.3		
Nitrite Nitrogen				<0.02	<0.02		
Nitrate Nitrogen				1.4	1.6		
Total Nitrogen				3.7	3.5		
Phenol				<0.005	<0.005		

*Results are in milligrams per liter except as noted.

$>$ - Means greater than.

$<$ - Means less than.

Mississippi River Survey, 1961

Table 7 (cont'd)

ANALYTICAL AND FIELD DATA

Determinations*	$M+33.2_2$	$M+33.2_3$	M+33.2c	$M+33.2_{2d}$	M+34.9	$M+37.0_1$	$M+37.0_2$
Sample Number	5967	5968	5969	5970	5965	5934	5933
Date Collected	8-25-61	8-25-61	8-25-61	8-25-61	8-25-61	8-23-61	8-23-61
Time Collected	10:55 a.m.	11:05 a.m.		11:20 a.m.	10:30 a.m.	1:15 p.m.	1:10 p.m.
Temperature (°F)	73	73			73	74	75
Coliform Group Organisms (MPN/100 ml)	310,000	17,000		54,000	>24,000,000	2,700	3,300
Total Solids			470		670		
Total Volatile Matter			150		120		
Suspended Solids			54		42		
Suspended Volatile Matter			18		24		
Total Hardness as $CaCO_3$			280		250		
Alkalinity as $CaCO_3$			210		170		
pH Value	7.8	8.0			7.3	7.8	7.7
Chlorides			20		230		
Fluorides			1.1		9.5		
Dissolved Oxygen	3.9	6.1				5.8	5.9
Biochemical Oxygen Demand, 5-day			8.5		140		
Phosphorus (total)			0.43		8.8		
Nitrate Nitrogen			1.4		1.1		
Total Nitrogen			3.5		18		
Kjeldahl Nitrogen			2.1		17.0		
Phenol			<0.01		0.065		

*Results are in milligrams per liter except as noted.
> - Means greater than.
< - Means less than.

Mississippi River Survey, 1961

Table 7 (cont'd)

ANALYTICAL AND FIELD DATA

Determinations*	$M+37.0_3$	$M+37.0c_1$	$M+37.0_4$	$M+37.0_5$	$M+37.0_6$	$M+37.0c_2$	$M+37.0_{2d}$
Sample Number	5932	5936	5930	5929	5928	5931	5935
Date Collected	8-23-61	8-23-61	8-23-61	8-23-61	8-23-61	8-23-61	8-23-61
Time Collected	1:05 p.m.		1:00 p.m.	12:55 p.m.	12:50 p.m.		
Temperature (°F)	75		76	74	76		
Coliform Group Organisms	3,300		1,700	3,300	7,900		3,300
Total Solids		450				460	
Total Volatile Matter		120				140	
Suspended Solids		36				54	
Suspended Volatile Matter		14				20	
Total Hardness as $CaCO_3$		290				290	
Alkalinity as $CaCO_3$		220				210	
pH Value	7.8		8.3	8.1	7.9		
Chlorides		4.0				35	
Fluorides		0.22				0.30	
Dissolved Oxygen	6.0		15.0	10.7	7.7		
Biochemical Oxygen Demand, 5-day		8.3				11	
Phosphorus (total)		0.40				0.38	
Nitrate Nitrogen		1.9				2.0	
Total Nitrogen		3.5				3.8	
Kjeldahl Nitrogen		1.6				1.8	
Phenol		<0.01					

*Results are in milligrams per liter except as noted.

$>$ - Means greater than.

$<$ - Means less than.

Mississippi River Survey, 1961

Table 7 (cont'd)

ANALYTICAL AND FIELD DATA

Determinations*	M+39.1$_1$	M+39.1$_2$	M+39.1$_3$	M+39.1c	M+39.1$_{2d}$	M+39.4	M+39.6
Sample Number	5924	5923	5922	5925	5926	5927	5972
Date Collected	8-23-61	8-23-61	8-23-61	8-23-61	8-23-61	8-23-61	8-25-61
Time Collected	10:00 a.m.	9:55 a.m.	9:50 a.m.		10:30 a.m.	11:15 a.m.	1:30 p.m.
Temperature (^oF)	74	74	75			68	73
Coliform Group Organisms (MPN/100 ml)	1,300	1,700	7,900		2,300		160,000
Total Solids				440		1,500	520
Total Volatile Matter				150		250	170
Suspended Solids				33		100	99
Suspended Volatile Matter				15		80	24
Total Hardness as $CaCO_3$				290		270	290
Alkalinity as $CaCO_3$				210		390	210
pH Value	7.9	7.9	8.0			7.4	7.7
Chlorides				4.0		250	18
Dissolved Oxygen	6.1	6.0	7.0				5.5
Biochemical Oxygen Demand, 5-day				7.5		140	6.5
Phosphorus (total)				0.40		7.5	0.40
Ammonia Nitrogen						28	0.56
Organic Nitrogen						13	1.4
Nitrite Nitrogen						< 0.05	0.17
Nitrate Nitrogen				1.8		1.8	1.6
Total Nitrogen				3.4		43	
Kjeldahl Nitrogen				1.6			
Chromates (Hexavalent)				NF			
Total Chromates				<0.01			
Copper				0.1			

*Results are in milligrams per liter except as noted.
NF - Means none found.
>- Means greater than.
<- Means less than.

Mississippi River Survey, 1961

Table 7 (cont'd)

ANALYTICAL AND FIELD DATA

Determinations*	M+39.8$_1$	M+39.8$_2$	M+39.8$_3$	M+39.8$_4$	M+39.8c	M+39.8$_{2a}$	M+42.0$_1$
Sample Number	5893	5892	5891	5894	5896	5895	5888
Date Collected	8-22-61	8-22-61	8-22-61	8-22-61	8-22-61	8-22-61	8-22-61
Time Collected	1:40 p.m.	1:30 p.m.		1:40 p.m.		1:50 p.m.	10:45 a.m.
Temperature (^oF)	75	75	75				
Coliform Group Organisms	3,300	24,000	4,900	13,000		3,300	4,900
Total Solids					460		
Total Volatile Matter					150		
Suspended Solids					36		
Suspended Volatile Matter					13		
Total Hardness as $CaCO_3$					290		
Alkalinity as $CaCO_3$					190		
pH Value	7.7	7.8	7.7				7.9
Chlorides					6.2		
Dissolved Oxygen	2.7	2.9	6.0				4.7
Biochemical Oxygen Demand, 5-day					6.8		
Phosphorus (total)					0.34		
Nitrate Nitrogen					1.8		
Total Nitrogen					3.4		
Kjeldahl Nitrogen					1.6		

*Results are in milligrams per liter except as noted.

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Table 7 (cont'd)

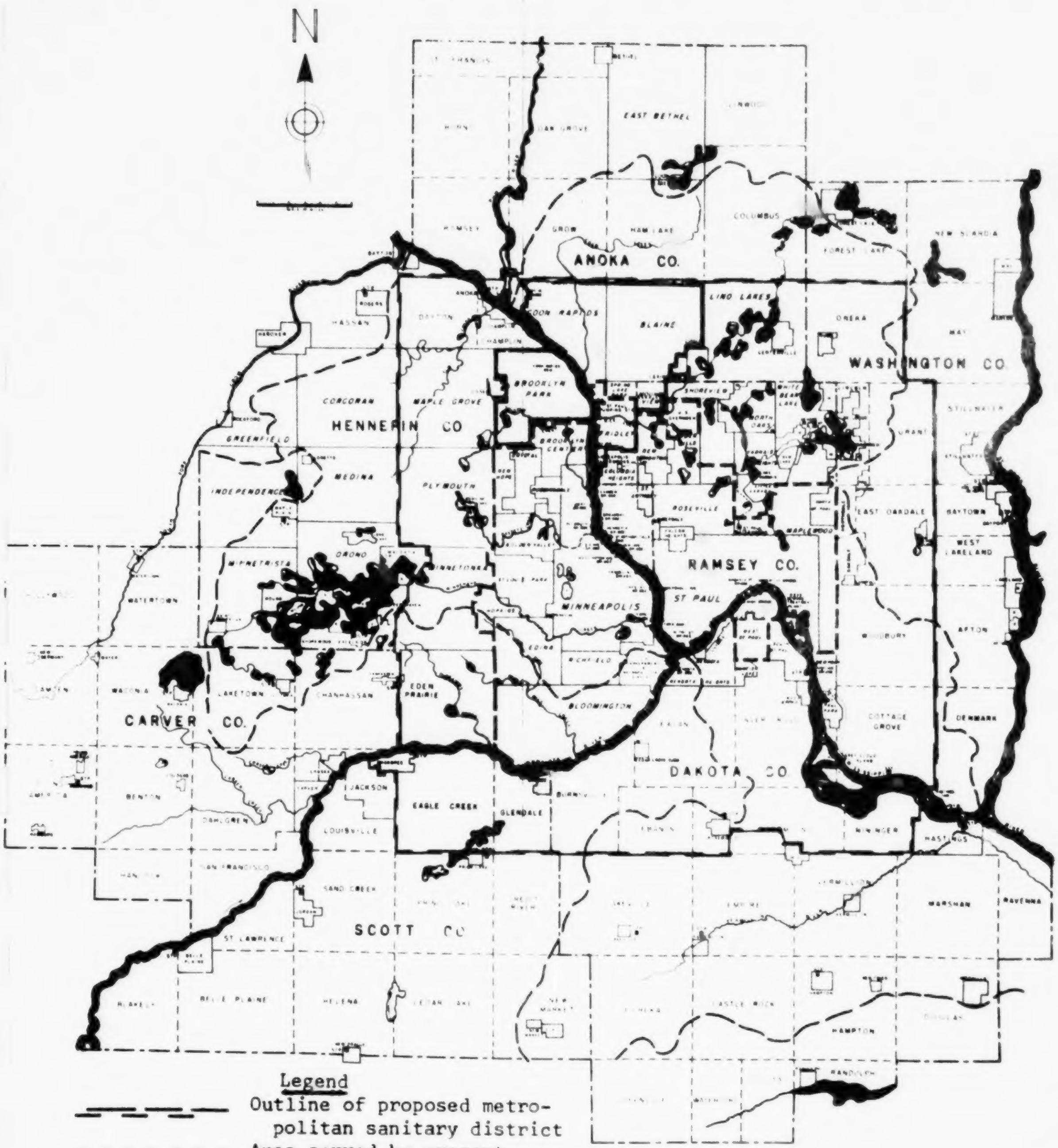
ANALYTICAL AND FIELD DATA

Determinations*	$M+42.0_2$	$M+42.0_3$	M+42.0c	$M+42.0_{2a}$
Sample Number	5887	5886	5889	5890
Date Collected	8-22-61	8-22-61	8-22-61	8-22-61
Time Collected	10:30 a.m.	10:15 a.m.		11:00 a.m.
Temperature	74	74		
Coliform Group Organisms (MPN/100 ml)	2,300	450		13,000
Total Solids			350	
Total Volatile Matter			120	
Suspended Solids			21	
Suspended Volatile Matter			10	
Total Hardness as $CaCO_3$			230	
Alkalinity as $CaCO_3$			180	
pH Value	7.9	8.0		
Chlorides			7.0	
Dissolved Oxygen	4.7	6.4		
Biochemical Oxygen Demand, 5-day			6.3	
Phosphorus (total)			0.24	
Nitrate Nitrogen			1.9	
Total Nitrogen			3.2	
Kjeldahl Nitrogen			1.3	

*Results are in milligrams per liter except as noted.

FIGURE 1

TWIN CITIES METROPOLITAN AREA



Legend

Outline of proposed metropolitan sanitary district

Area served by present Minneapolis-St. Paul sanitary district

North suburban sanitary sewer district

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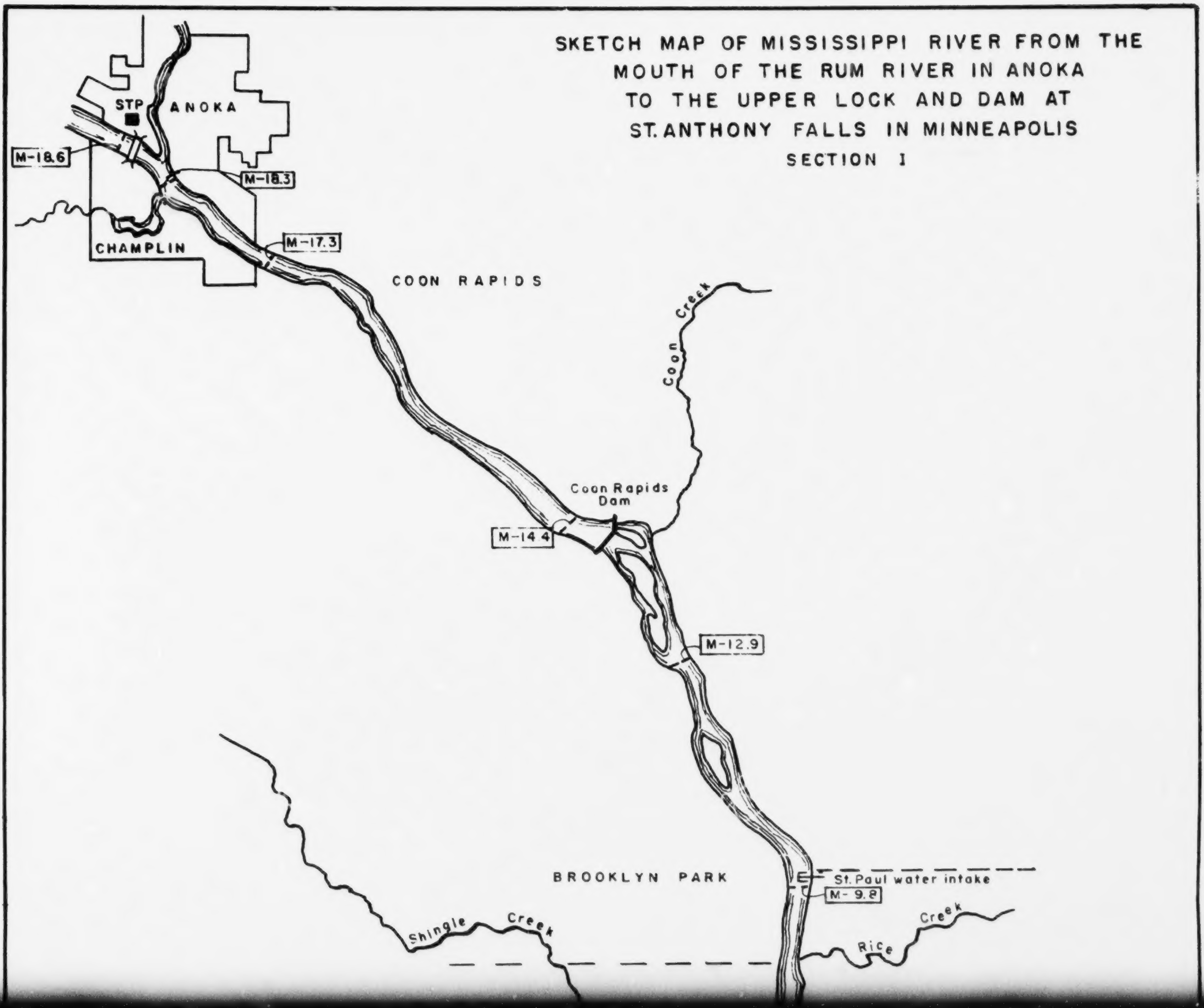
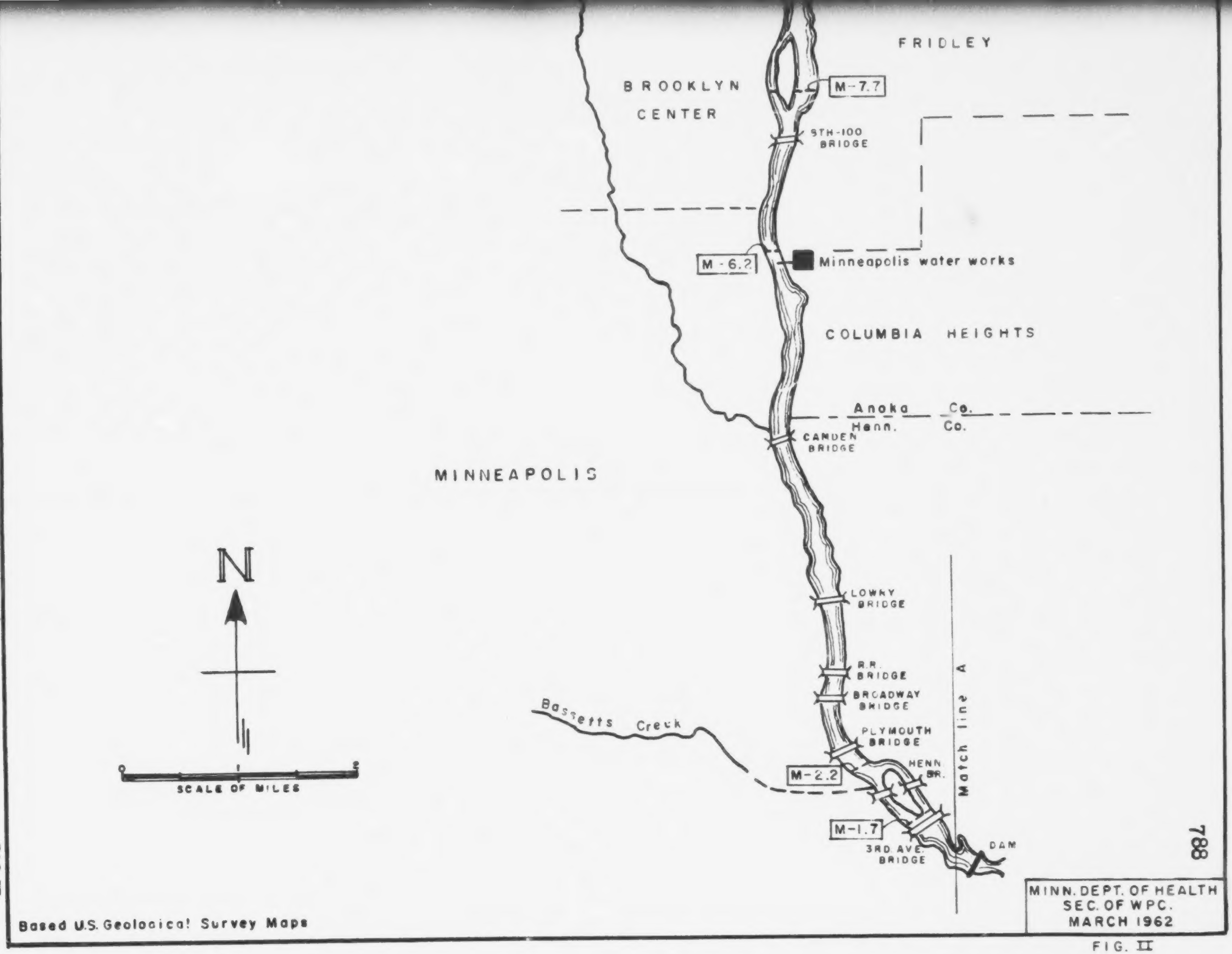


SKETCH MAP OF MISSISSIPPI RIVER FROM THE
MOUTH OF THE RUM RIVER IN ANOKA
TO THE UPPER LOCK AND DAM AT
ST. ANTHONY FALLS IN MINNEAPOLIS
SECTION I

A



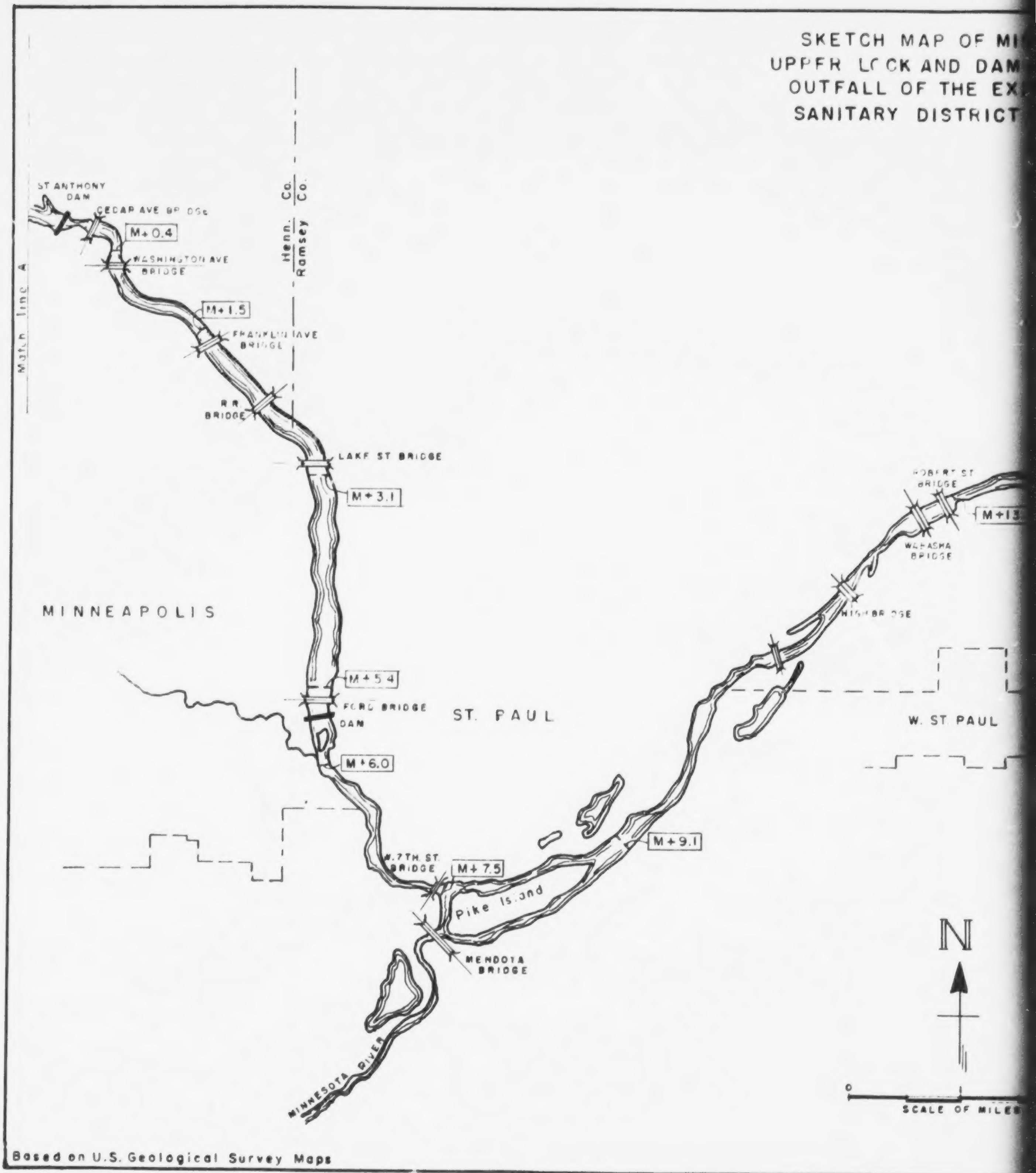
MINN. DEPT. OF HEALTH
SEC. OF WPC.
MARCH 1962

Based U.S. Geological Survey Maps

FIG. II

B

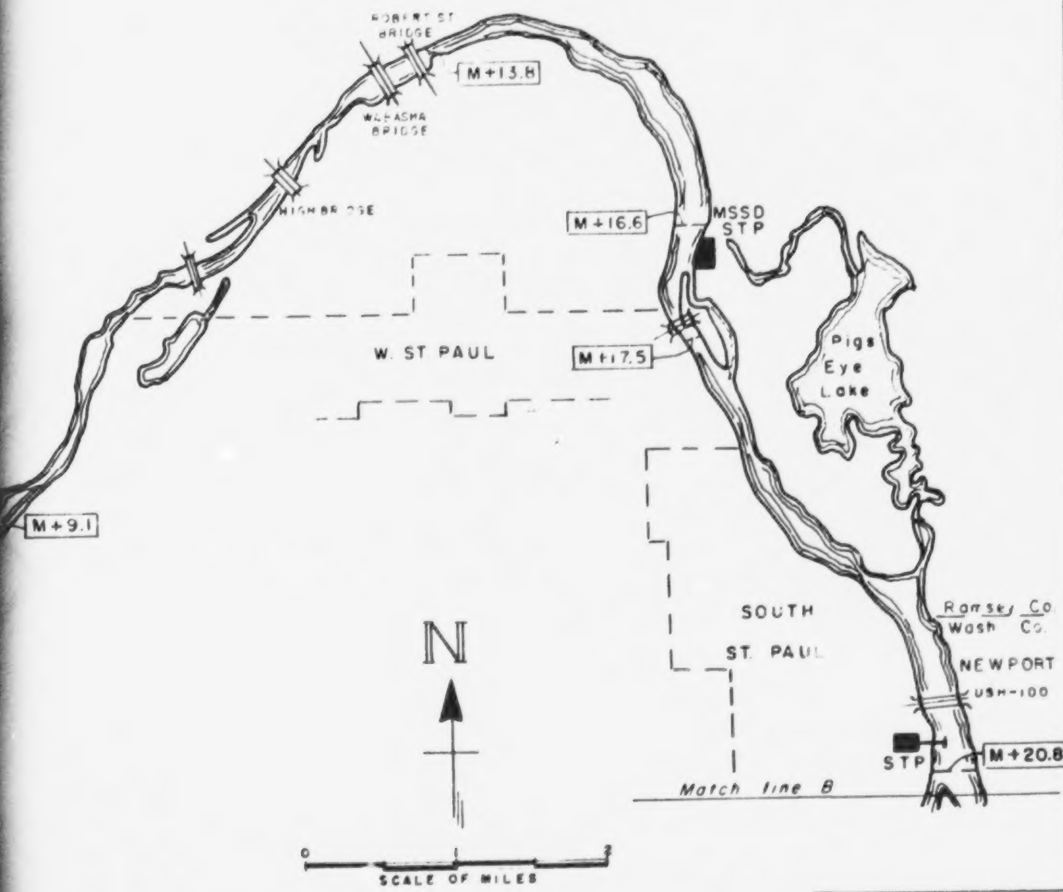
SKETCH MAP OF MI
UPPER LOCK AND DAM
OUTFALL OF THE EX
SANITARY DISTRICT



Based on U.S. Geological Survey Maps

A

SKETCH MAP OF MISSISSIPPI RIVER FROM THE UPPER LOCK AND DAM OF ST. ANTHONY FALLS TO THE OUTFALL OF THE EXISTING MINNEAPOLIS-ST. PAUL SANITARY DISTRICT SEWAGE TREATMENT PLANT



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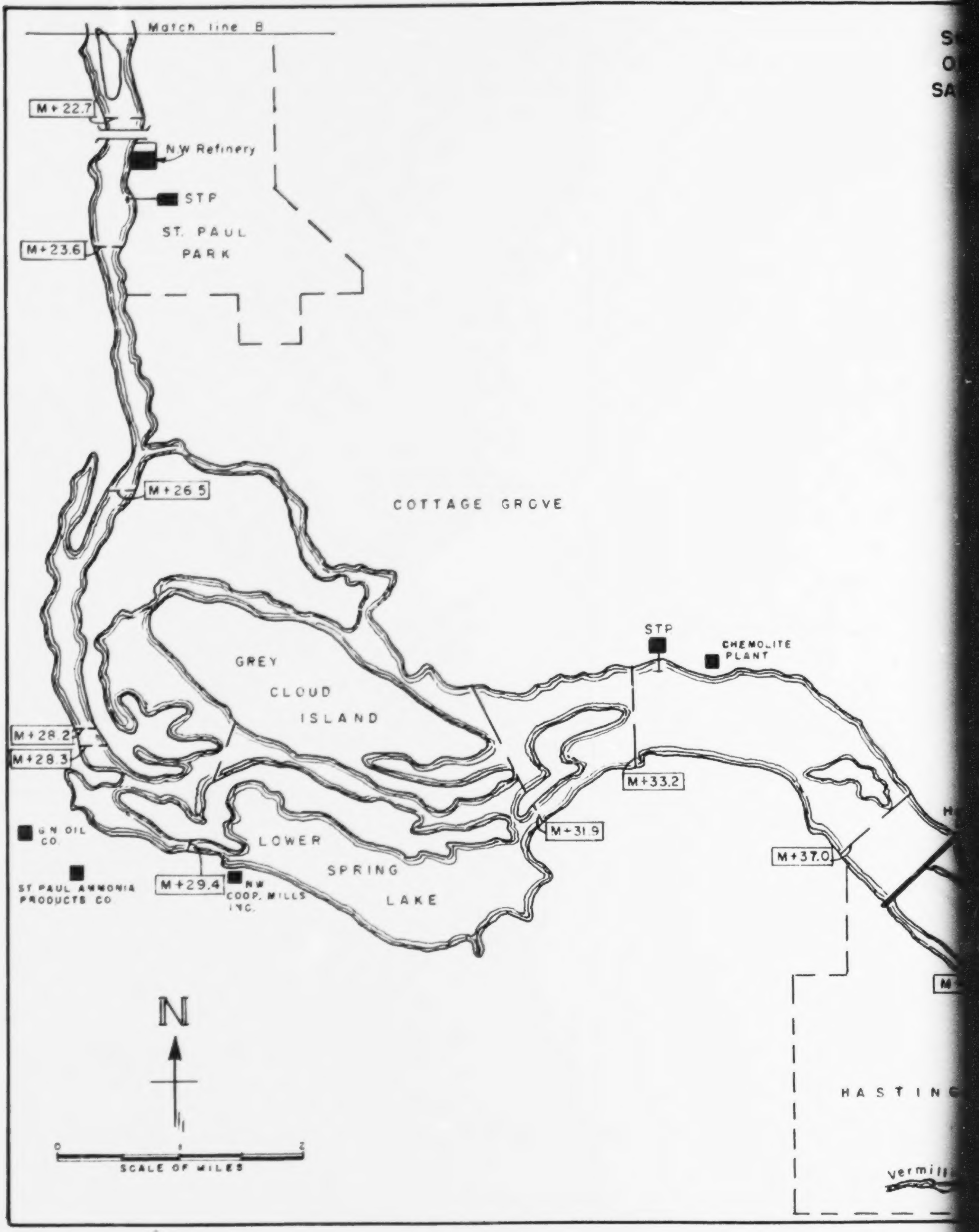
SEC. OF W.P.C.
MARCH 1962

FIG. III

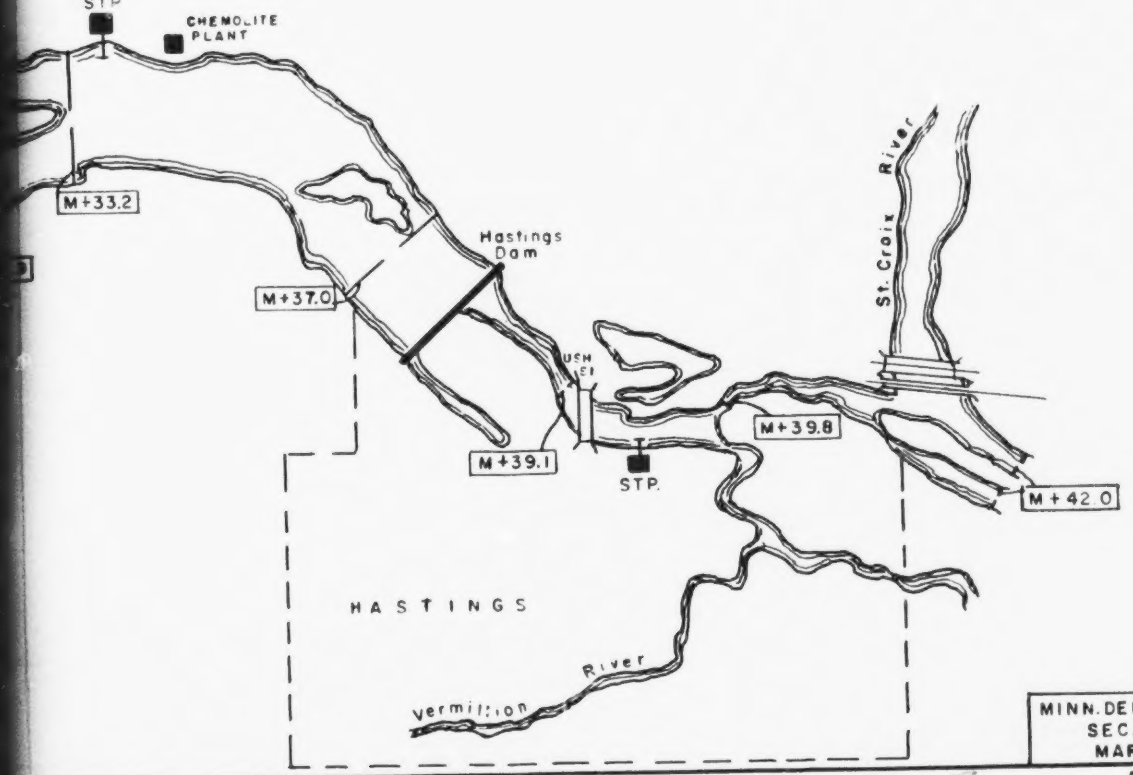
B

L-408


S
O
SA
Match line B
M+22.7
N.W. Refinery
STP
ST. PAUL PARK
M+23.6
M+26.5
COTTAGE GROVE
GREY CLOUD ISLAND
STP
CHEMOLITE PLANT
M+28.2
M+28.3
M+33.2
M+31.9
G N OIL CO.
LOWER SPRING LAKE
M+37.0
ST PAUL AMMONIA PRODUCTS CO
M+29.4
NW COOP. MILLS INC.
H
M+
N
HASTING
0
1
2
SCALE OF MILES
vermill

A

SKETCH MAP OF MISSISSIPPI RIVER FROM THE OUTFALL OF THE EXISTING MINNEAPOLIS-ST. PAUL SANITARY DISTRICT SEWAGE TREATMENT PLANT TO THE JUNCTION WITH THE ST. CROIX RIVER BELOW HASTINGS



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SEC. OF WPC
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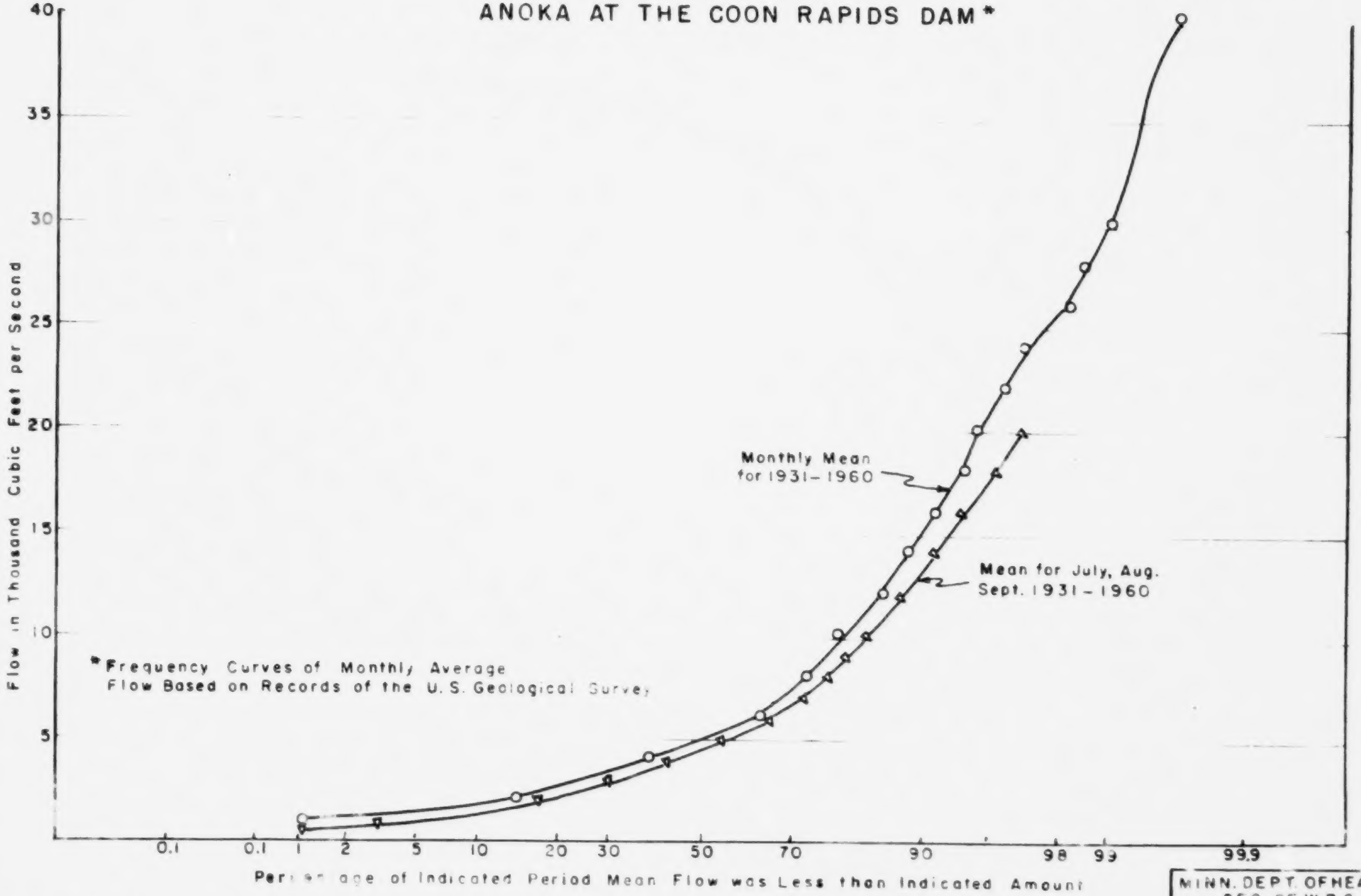
FIG. IV

13

MISSISSIPPI RIVER FLOW NEAR ANOKA AT THE COON RAPIDS DAM*



*Frequency Curves of Monthly Average Flow Based on Records of the U.S. Geological Survey

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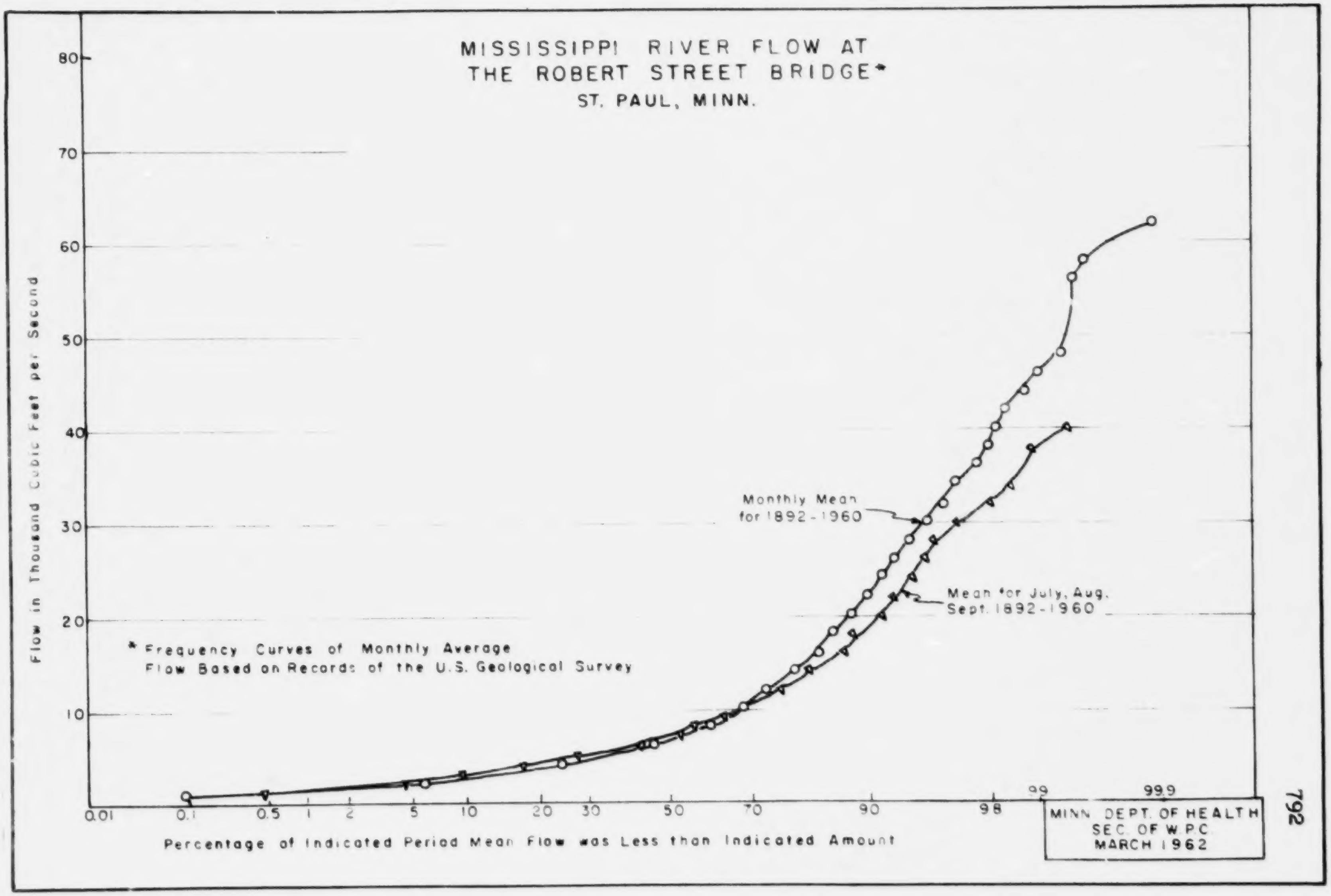
MARCH 1962

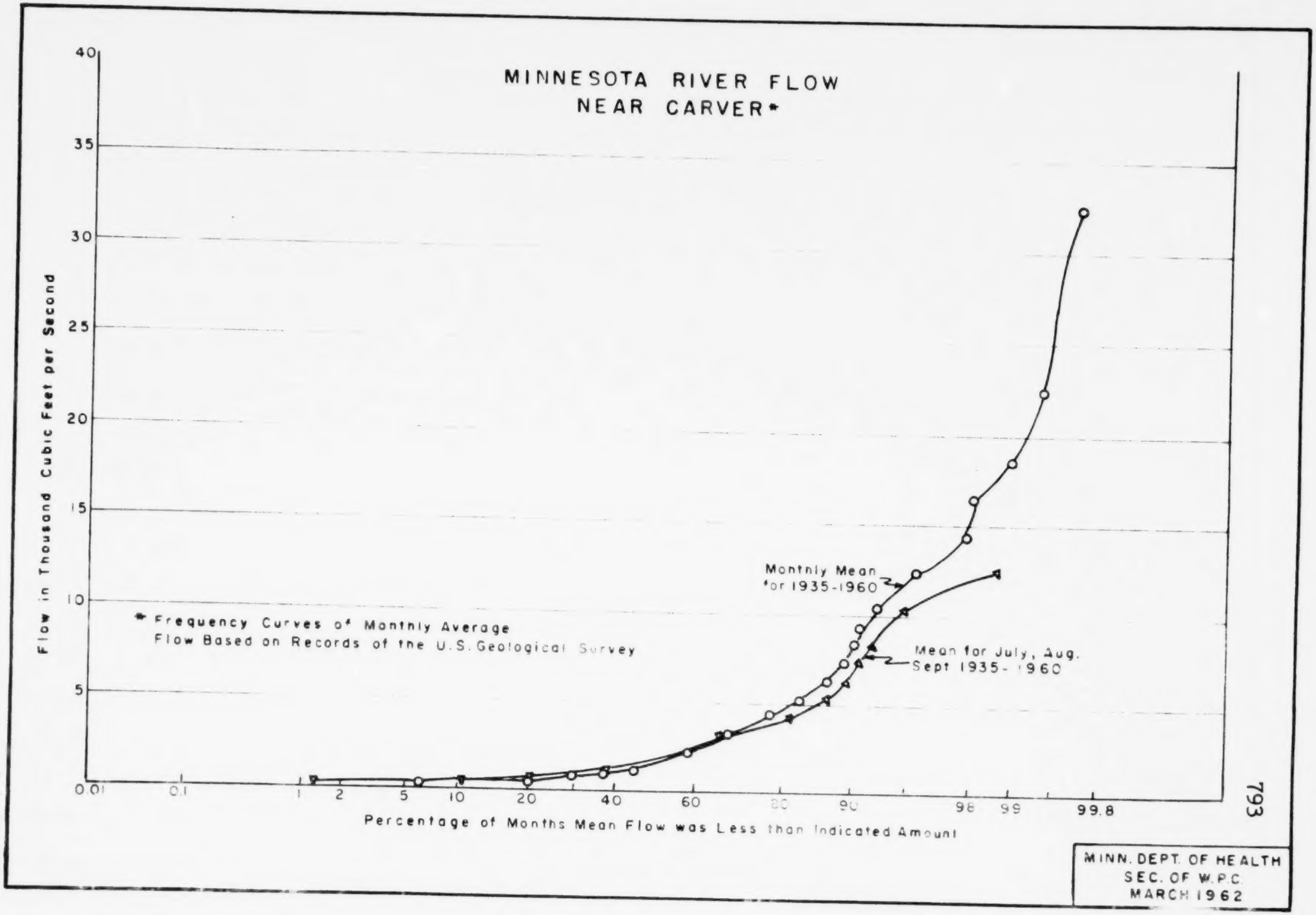
FIG. V



MISSISSIPPI RIVER FLOW AT
THE ROBERT STREET BRIDGE*
ST. PAUL, MINN.

* Frequency Curves of Monthly Average
Flow Based on Records of the U.S. Geological Survey

MINN. DEPT. OF HEALTH
SEC. OF W.P.C.
MARCH 1962



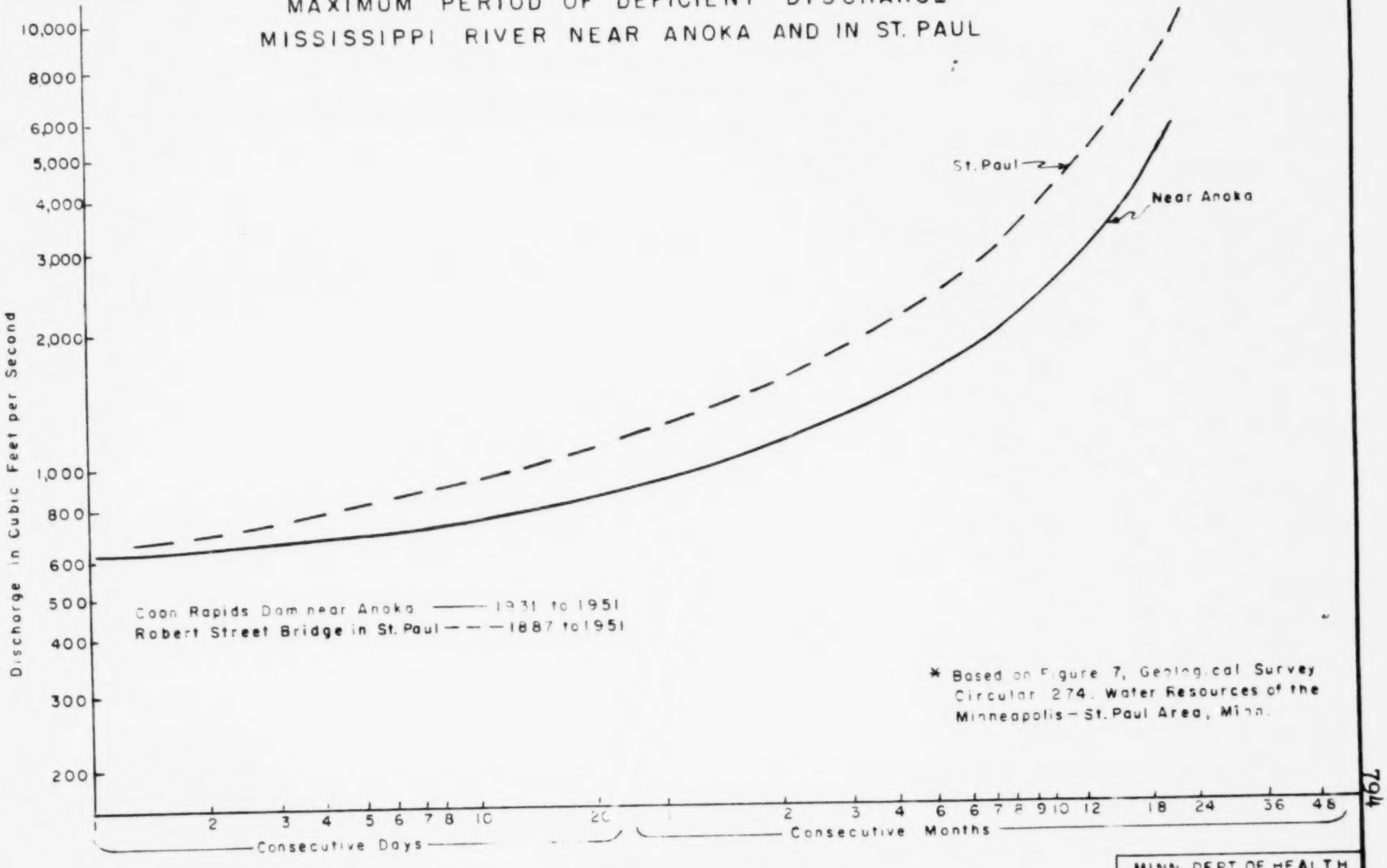
* Frequency Curves of Monthly Average Flow Based on Records of the U.S. Geological Survey

MINN. DEPT. OF HEALTH
SEC. OF W.P.C.
MARCH 1962

FIG. VII

794

MAXIMUM PERIOD OF DEFICIENT DISCHARGE*
MISSISSIPPI RIVER NEAR ANOKA AND IN ST. PAUL



* Based on Figure 7, Geological Survey Circular 274. Water Resources of the Minneapolis – St. Paul Area, Minn.

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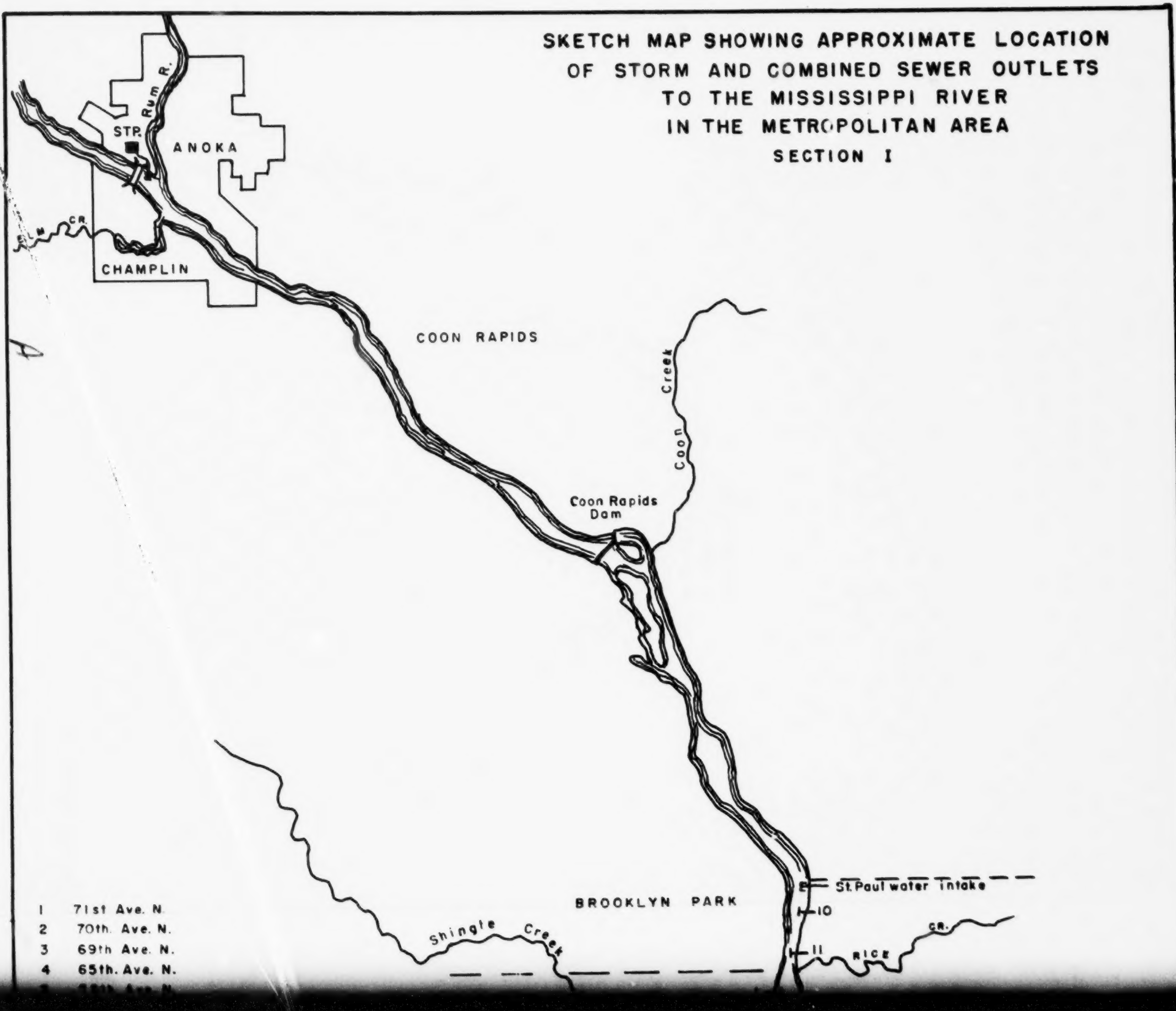
MARCH 1962

L-412

SKETCH MAP SHOWING APPROXIMATE LOCATION OF STORM AND COMBINED SEWER OUTLETS TO THE MISSISSIPPI RIVER IN THE METROPOLITAN AREA

SECTION I



B

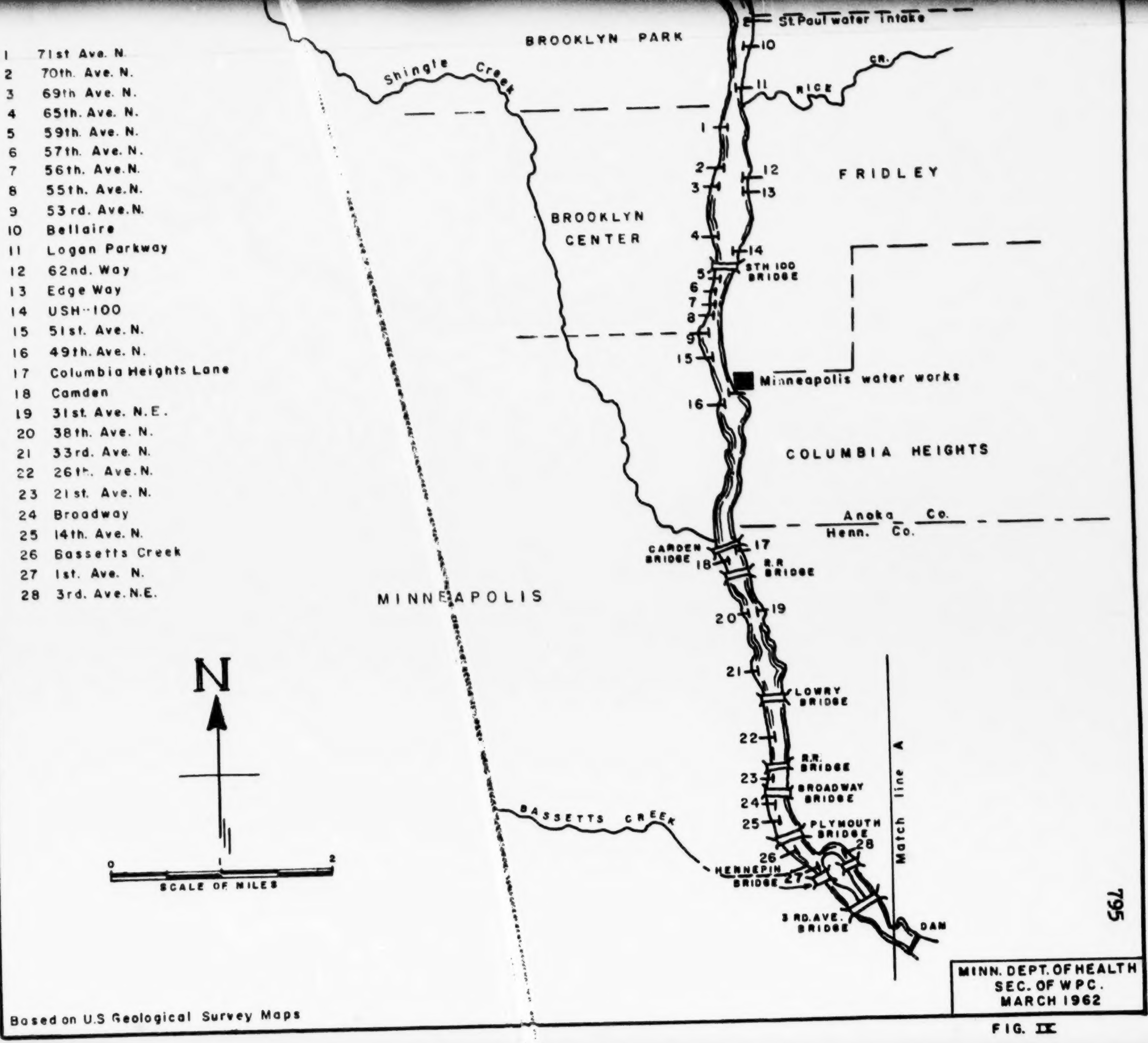


FIG. IX

FIG. IX

SKETCH MAP SHOWIN
OF STORM AND C
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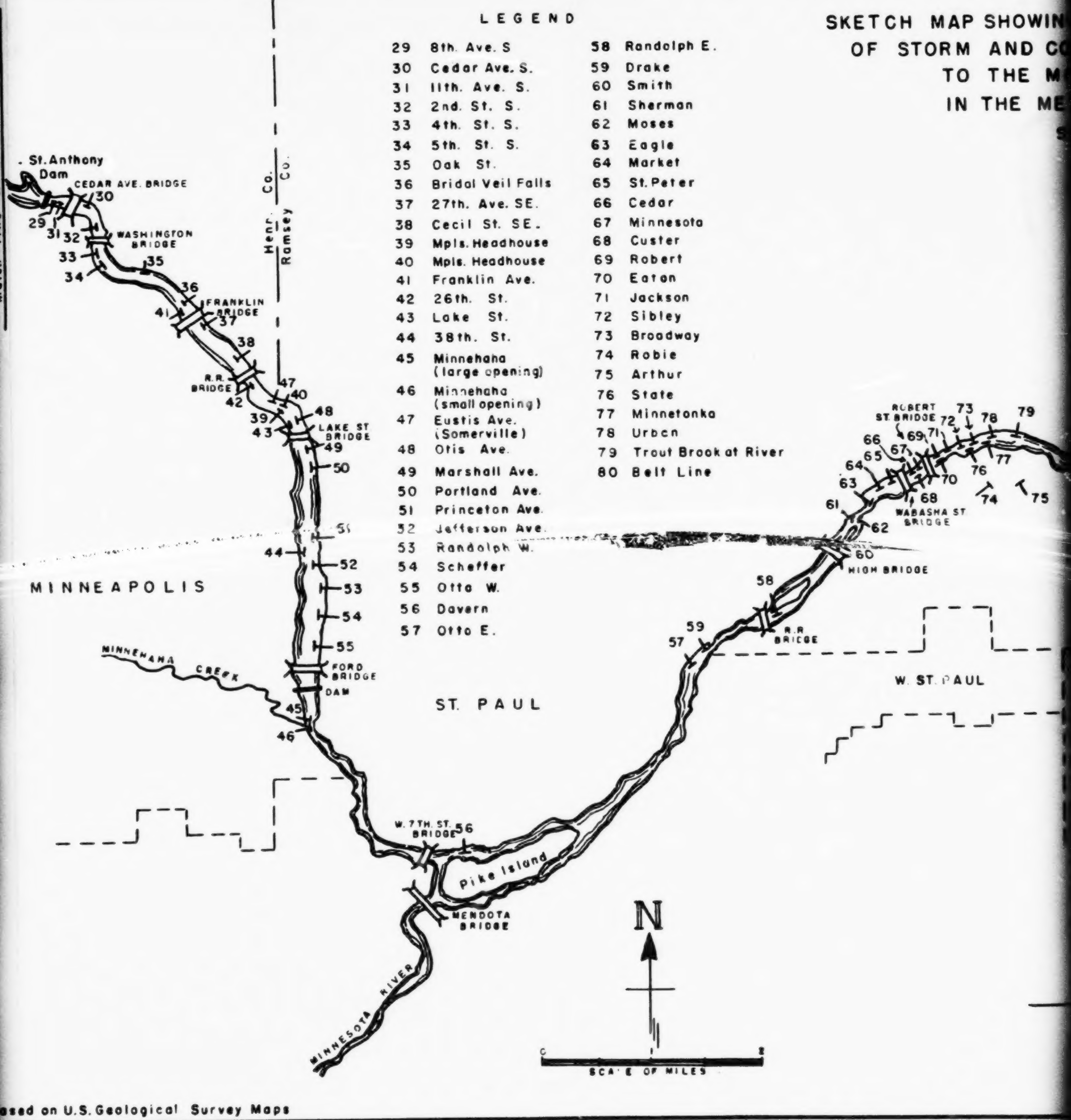
IN THE ME
S



LEGEND

29	8th. Ave. S
30	Cedar Ave. S.
31	11th. Ave. S.
32	2nd. St. S.
33	4th. St. S.
34	5th. St. S.
35	Oak St.
36	Bridal Veil Falls
37	27th. Ave. SE.
38	Cecil St. SE.
39	Mpls. Headhouse
40	Mpls. Headhouse
41	Franklin Ave.
42	26th. St.
43	Lake St.
44	38th. St.
45	Minnehaha (large opening)
46	Minnehaha (small opening)
47	Eustis Ave. (Somerville)
48	Otis Ave.
49	Marshall Ave.
50	Portland Ave.
51	Princeton Ave.
52	Jefferson Ave.
53	Randolph W.
54	Scheffer
55	Otto W.
56	Davern
57	Otto E.
58	Randolph E.
59	Drake
60	Smith
61	Sherman
62	Moses
63	Eagle
64	Market
65	St. Peter
66	Cedar
67	Minnesota
68	Custer
69	Robert
70	Eaton
71	Jackson
72	Sibley
73	Broadway
74	Robie
75	Arthur
76	State
77	Minnetonka
78	Urban
79	Trout Brook at River
80	Belt Line

ased on U.S. Geological Survey Maps

A

796

SKETCH MAP SHOWING APPROXIMATE LOCATION OF STORM AND COMBINED SEWER OUTLETS TO THE MISSISSIPPI RIVER IN THE METROPOLITAN AREA

SECTION 2

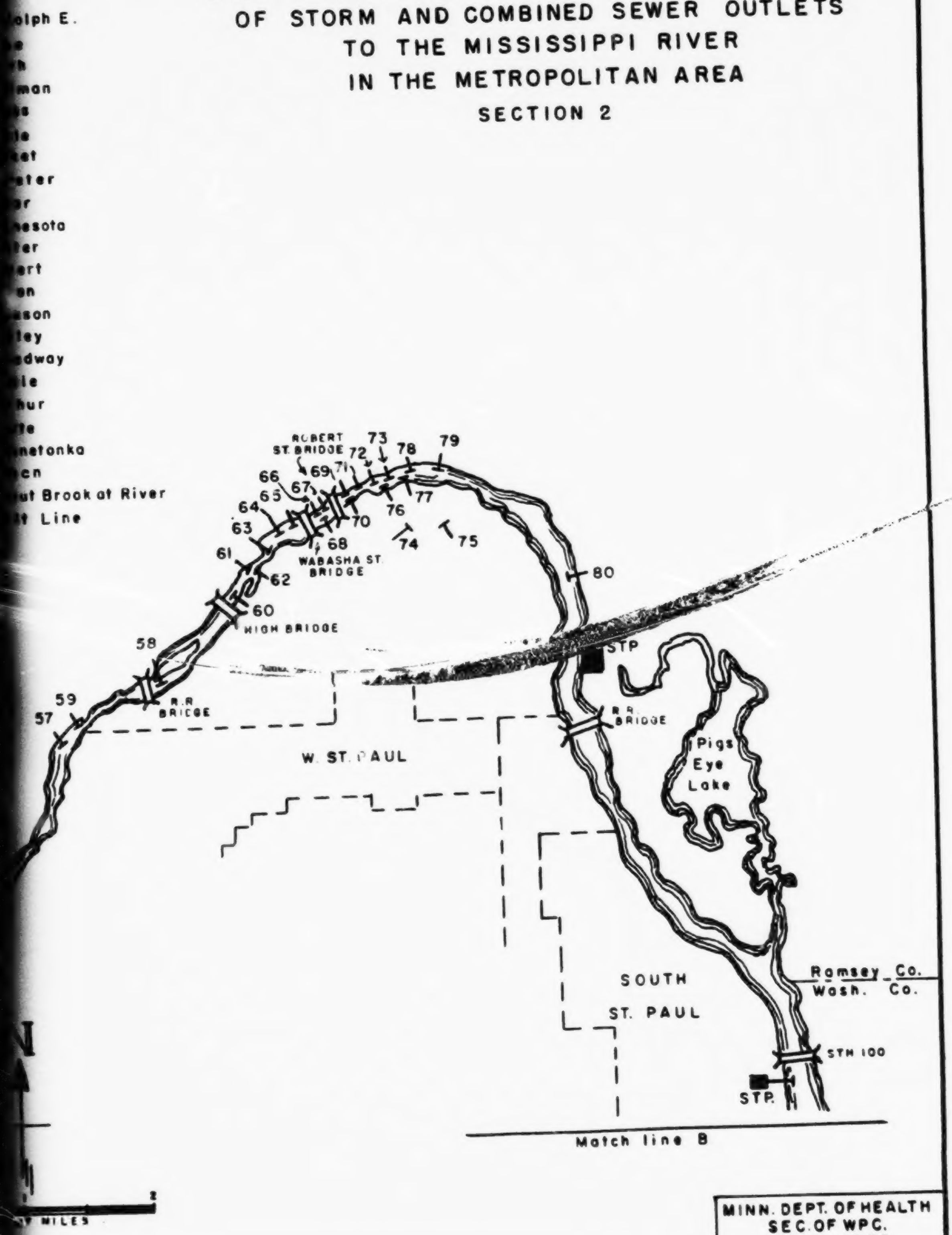


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FIG. I

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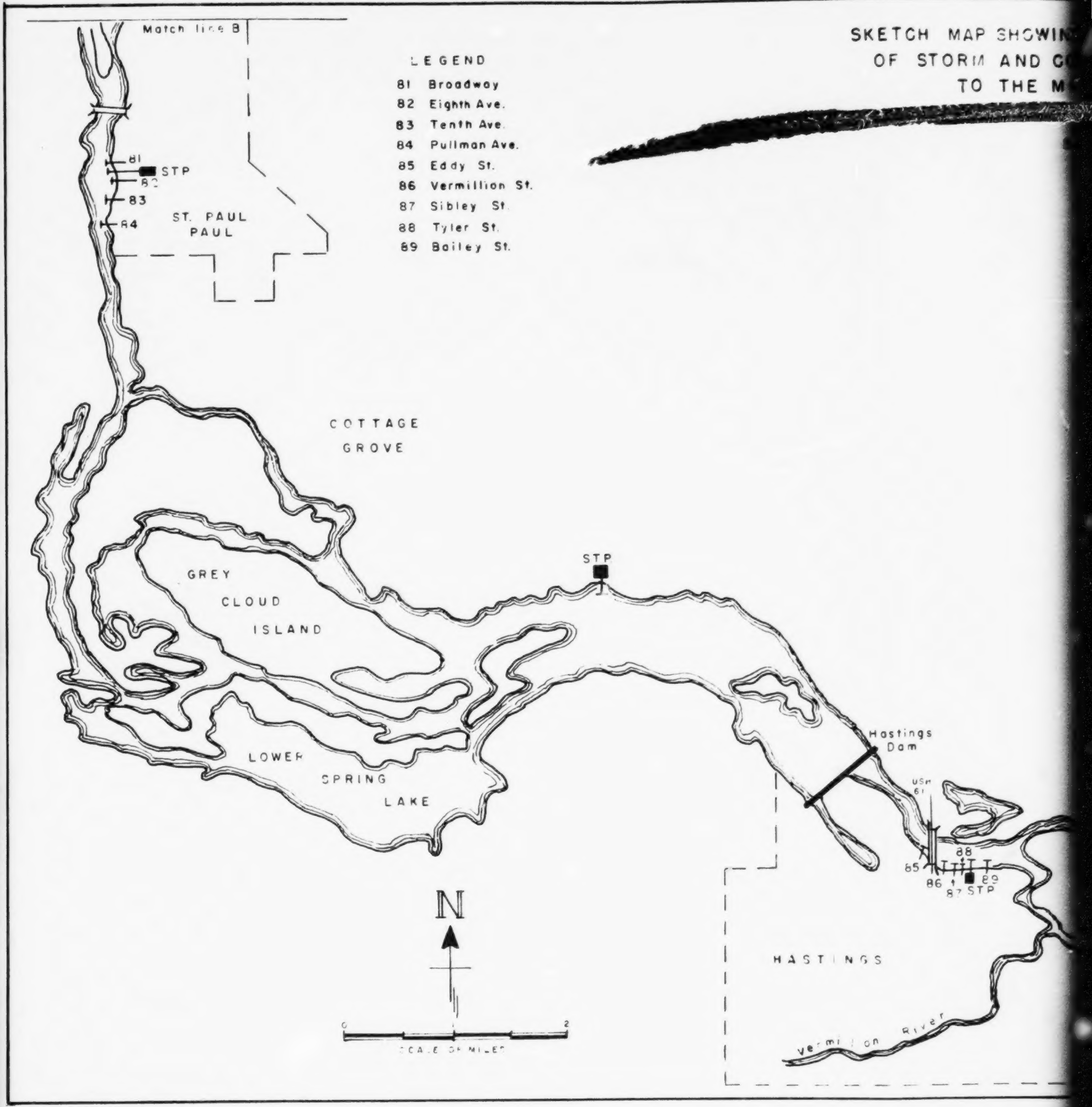
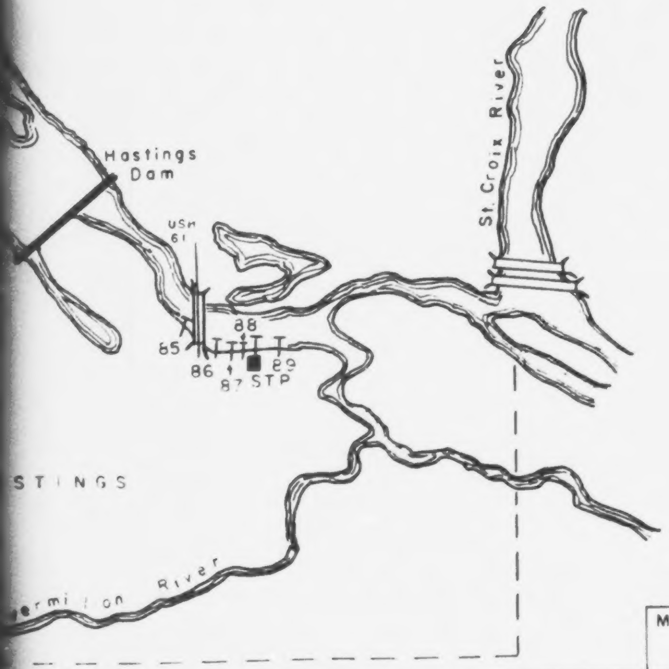

SKETCH MAP SHOWIN
OF STORM AND C
TO THE M

A

SKETCH MAP SHOWING APPROXIMATE LOCATION OF STORM AND COMBINED SEWER OUTLETS TO THE MISSISSIPPI RIVER IN THE METROPOLITAN AREA

SECTION 3



MINN. DEPT. OF HEALTH
SEC. OF WPC.
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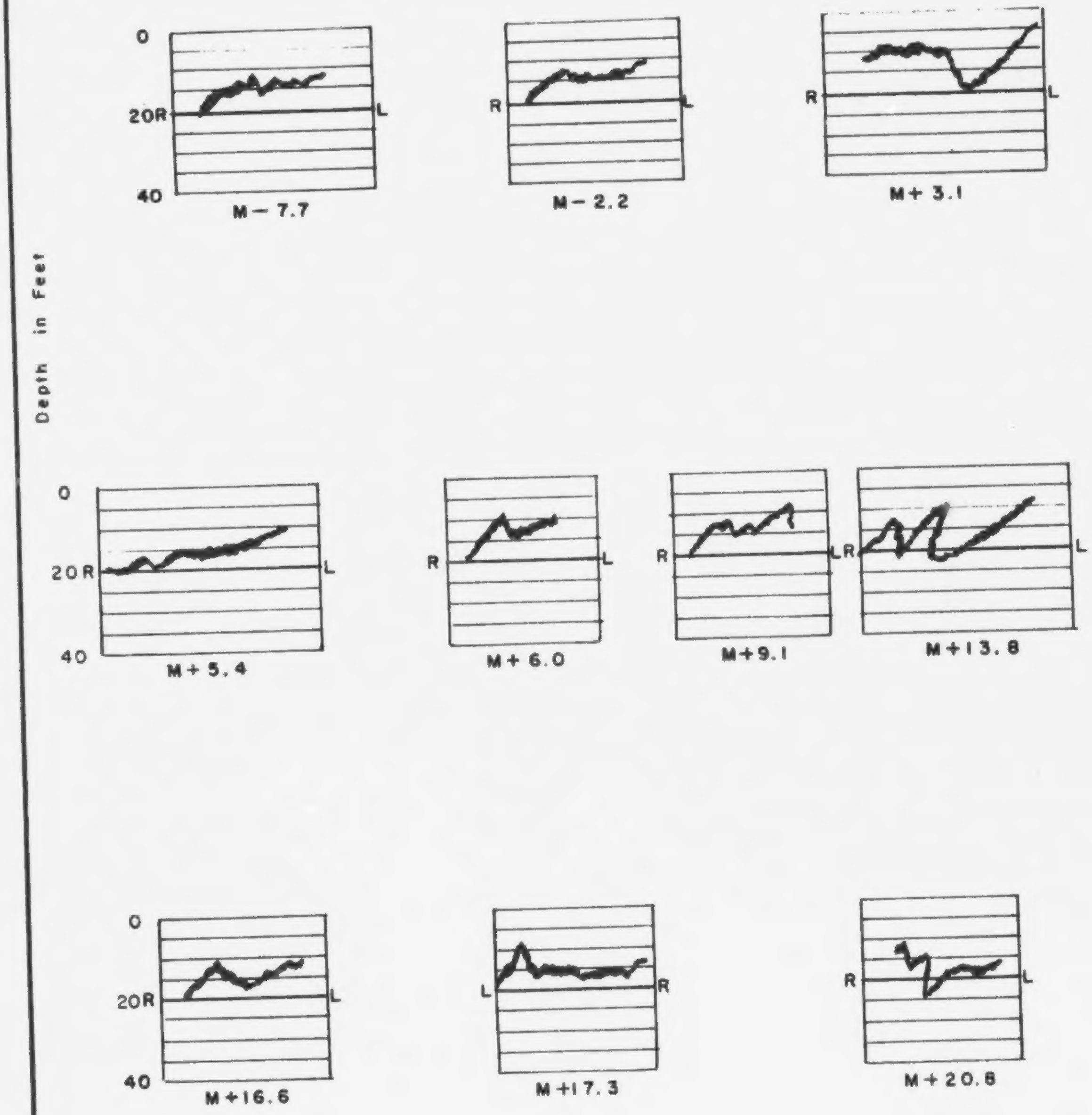
FIG. XI

MISSISSIPPI RIVER SURVEY
RIVER BOTTOM CROSS-SECTIONS
BY RECORDING DEPTH SOUNDER
AUGUST 22 to September 27, 1961



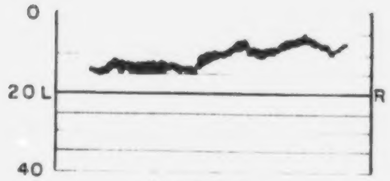
L – Left bank
R – Right bank

MINN. DEPT. OF HEALTH
SEC. OF WPC.
MARCH 1962

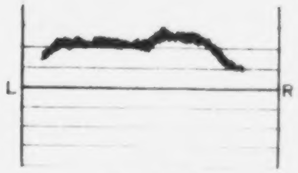
FIG. XIII

MISSISSIPPI RIVER SURVEY

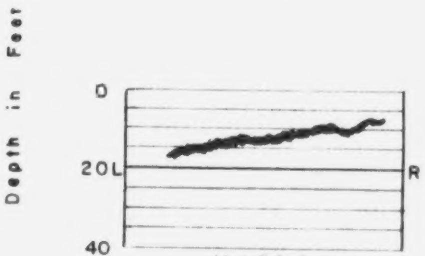
RIVER BOTTOM CROSS-SECTIONS
BY RECORDING DEPTH SOUNDER
AUGUST 22 to September 27, 1961



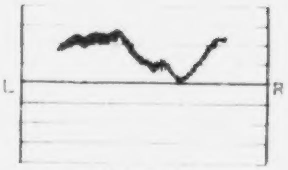
M + 22.7



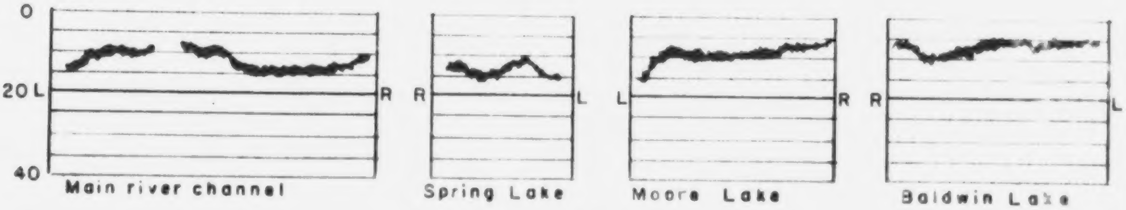
M + 23.6



M + 26.5



M + 28.3



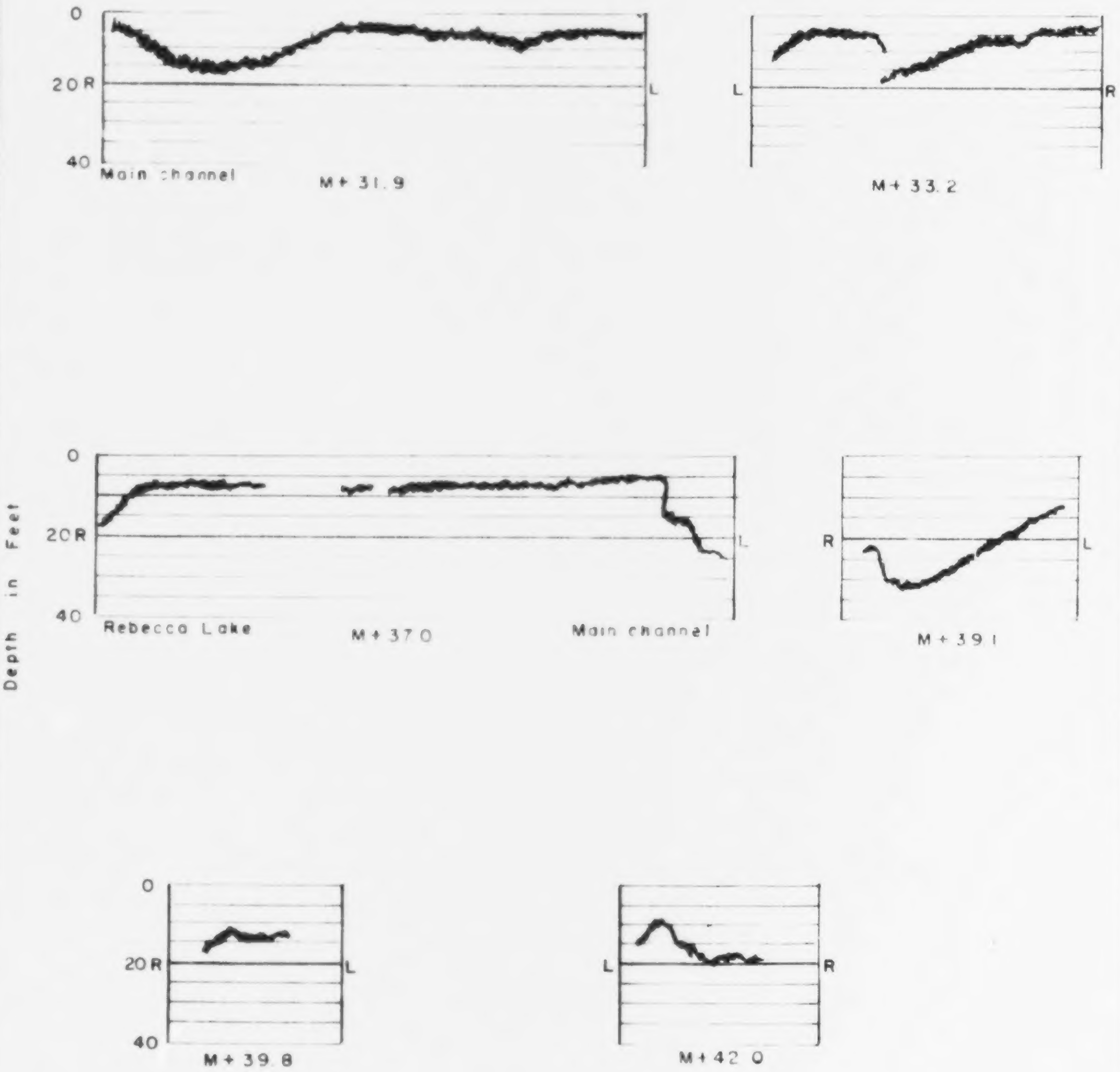
M + 29.4

L - Left bank
R - Right bank

MINN DEPT. OF HEALTH
SEC. OF WPC.
MARCH, 19[illegible]

FIG. [illegible]

MISSISSIPPI RIVER SURVEY
RIVER BOTTOM CROSS-SECTIONS
BY RECORDING DEPTH SOUNDER
AUGUST 22 to September 27, 1961

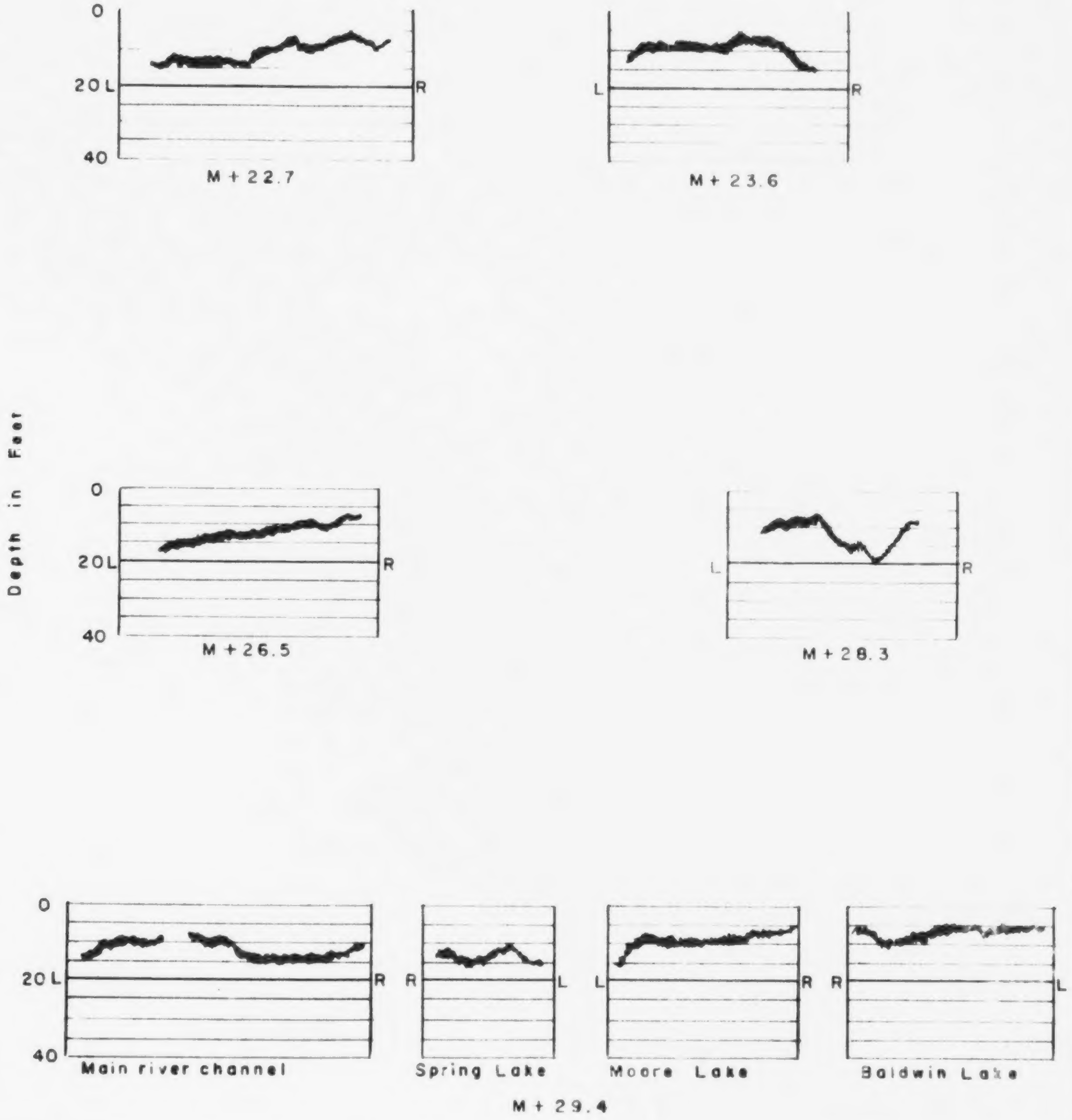


L - Left bank
R - Right bank

MINN. DEPT. OF HEALTH
SEC. OF WPC.
MARCH, 1962

FIG. XIV

MISSISSIPPI RIVER SURVEY
RIVER BOTTOM CROSS-SECTIONS
BY RECORDING DEPTH SOUNDER
AUGUST 22 to September 27, 1961



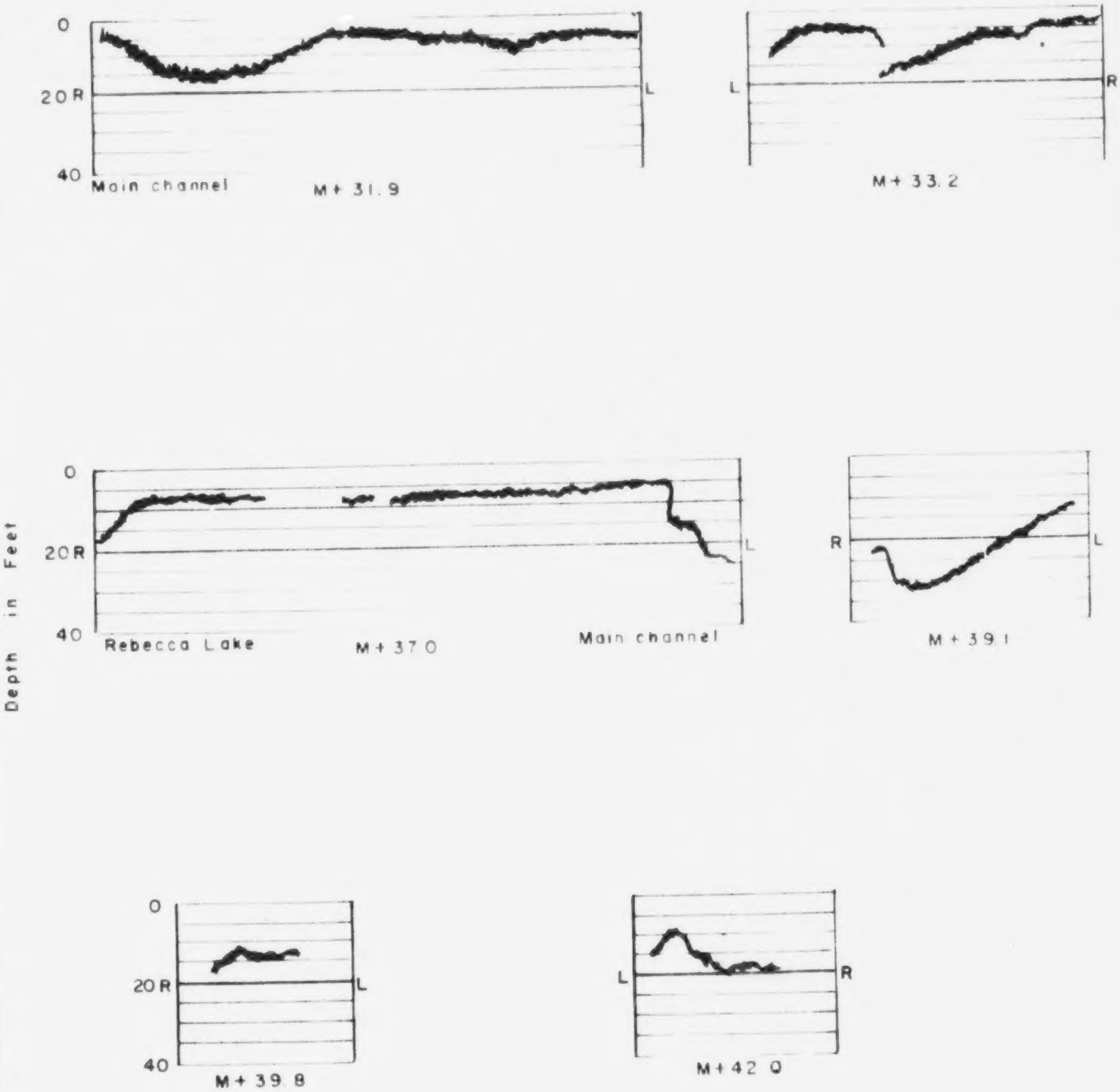
L - Left bank
R - Right bank

MINN. DEPT. OF HEALTH
SEC. OF WPC.
MARCH, 1961

FIG. XII

MISSISSIPPI RIVER SURVEY

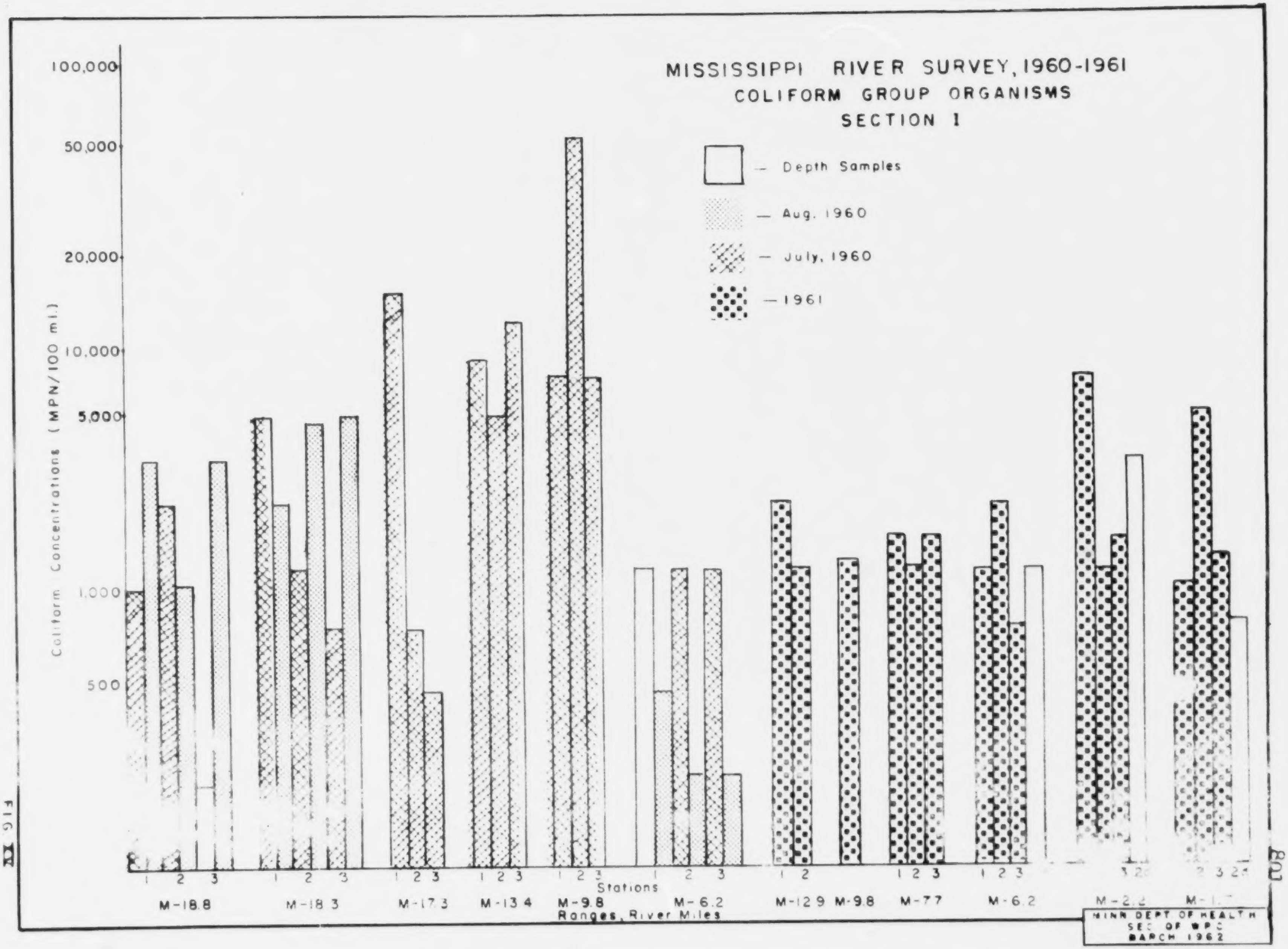
RIVER BOTTOM CROSS-SECTIONS
BY RECORDING DEPTH SOUNDER
AUGUST 22 to September 27, 1961



L - Left bank
R - Right bank

MINN. DEPT. OF HEALTH
SEC. OF WPC.
MARCH, 1962

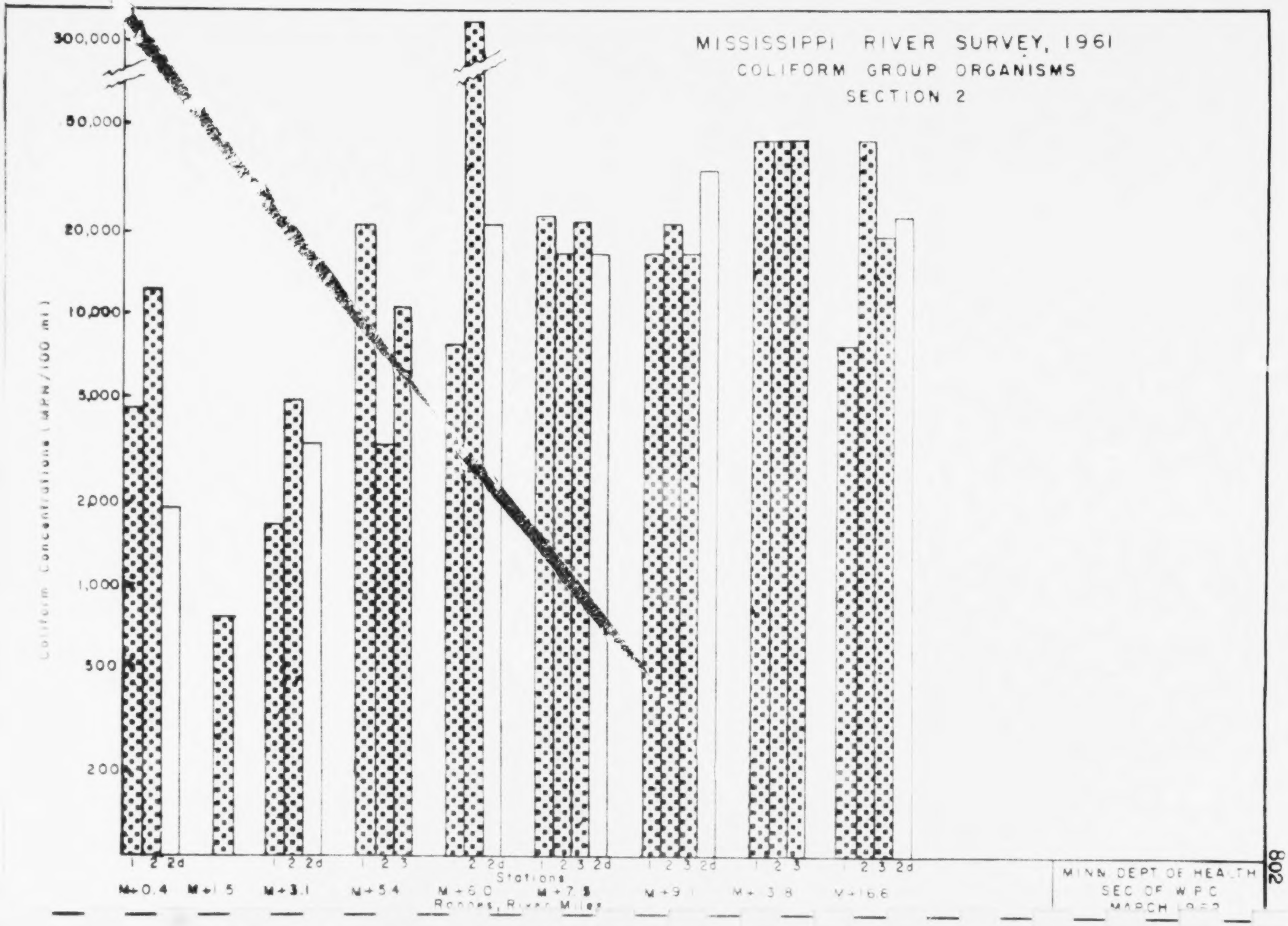
FIG. XIV



MISSISSIPPI RIVER SURVEY, 1960-1961
COLIFORM GROUP ORGANISMS
SECTION I

FIG. XV

801



MISSISSIPPI RIVER SURVEY, 1961
COLIFORM GROUP ORGANISMS
SECTION 2

MINN DEPT OF HEALTH
SEC OF W.P.C
MARCH 1962

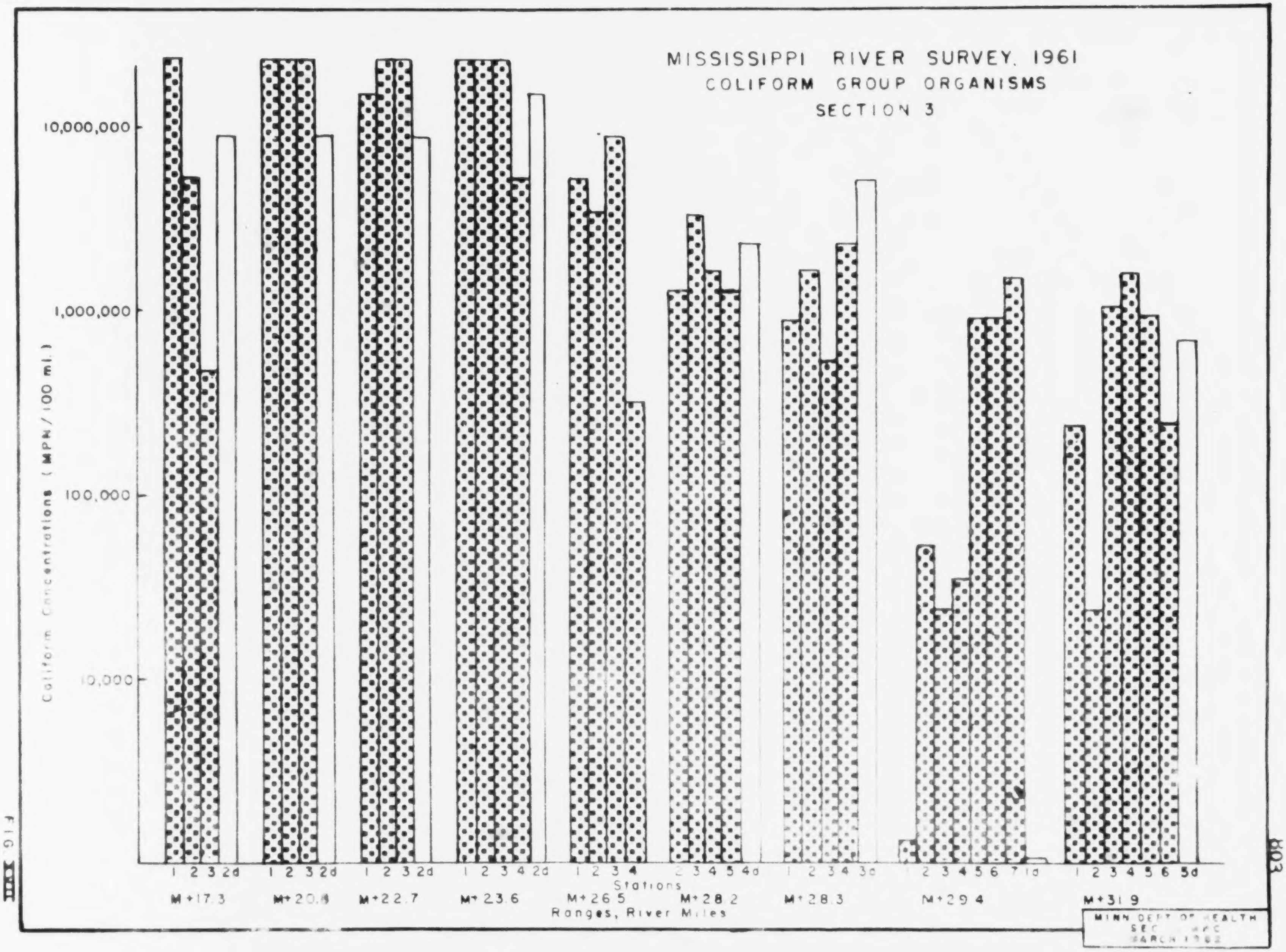
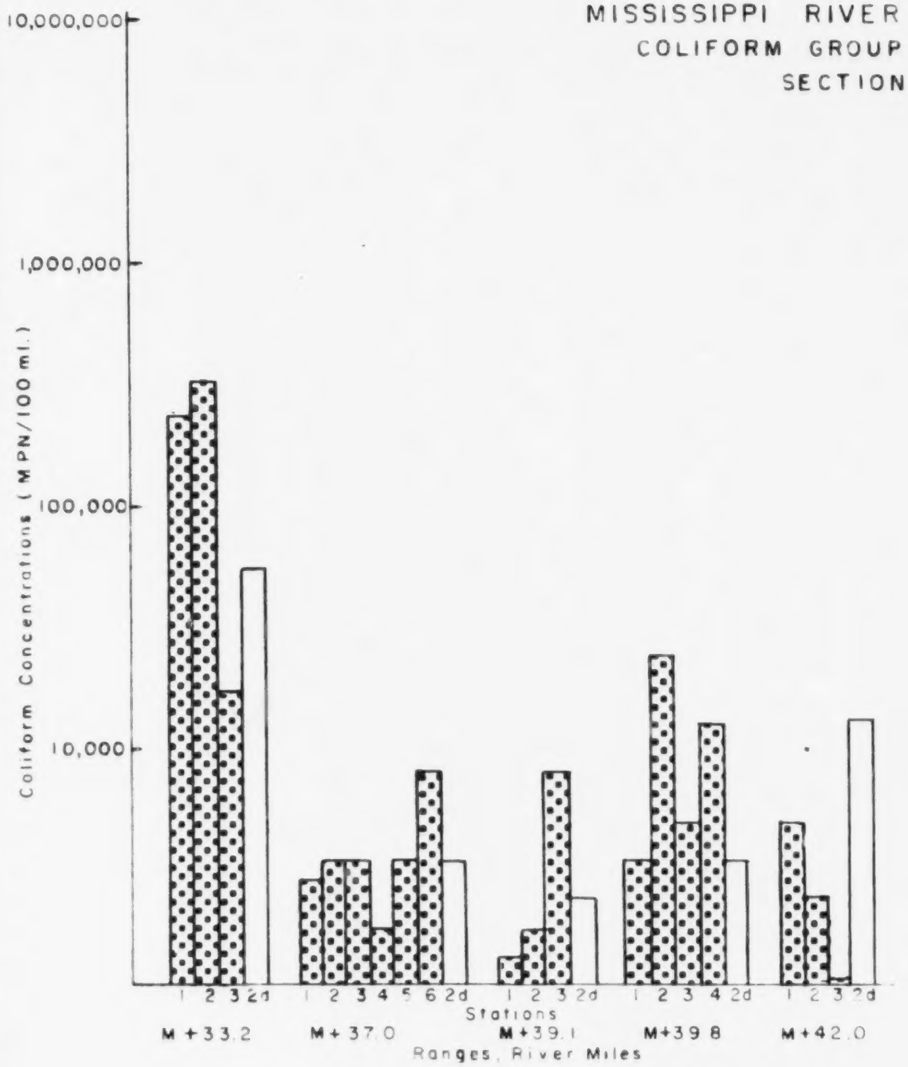

MISSISSIPPI RIVER SURVEY, 1961
COLIFORM GROUP ORGANISMS
SECTION 3
Coliform Concentrations (MPN / 100 ml.)
10,000,000
1,000,000
100,000
10,000
1 2 3 2d
M+17.3
1 2 3 2d
M+20.8
1 2 3 2d
M+22.7
1 2 3 4 2d
M+23.6
1 2 3 4
M+26.5
2 3 4 5 4d
M+28.2
1 2 3 4 3d
M+28.3
1 2 3 4 5 6 7 1d
M+29.4
1 2 3 4 5 6 5d
M+31.9
Stations
Ranges, River Miles
MINN DEPT OF HEALTH
SEC. WPC
MARCH 1962

FIG. XVII

MISSISSIPPI RIVER SURVEY, 1961
COLIFORM GROUP ORGANISMS
SECTION 3

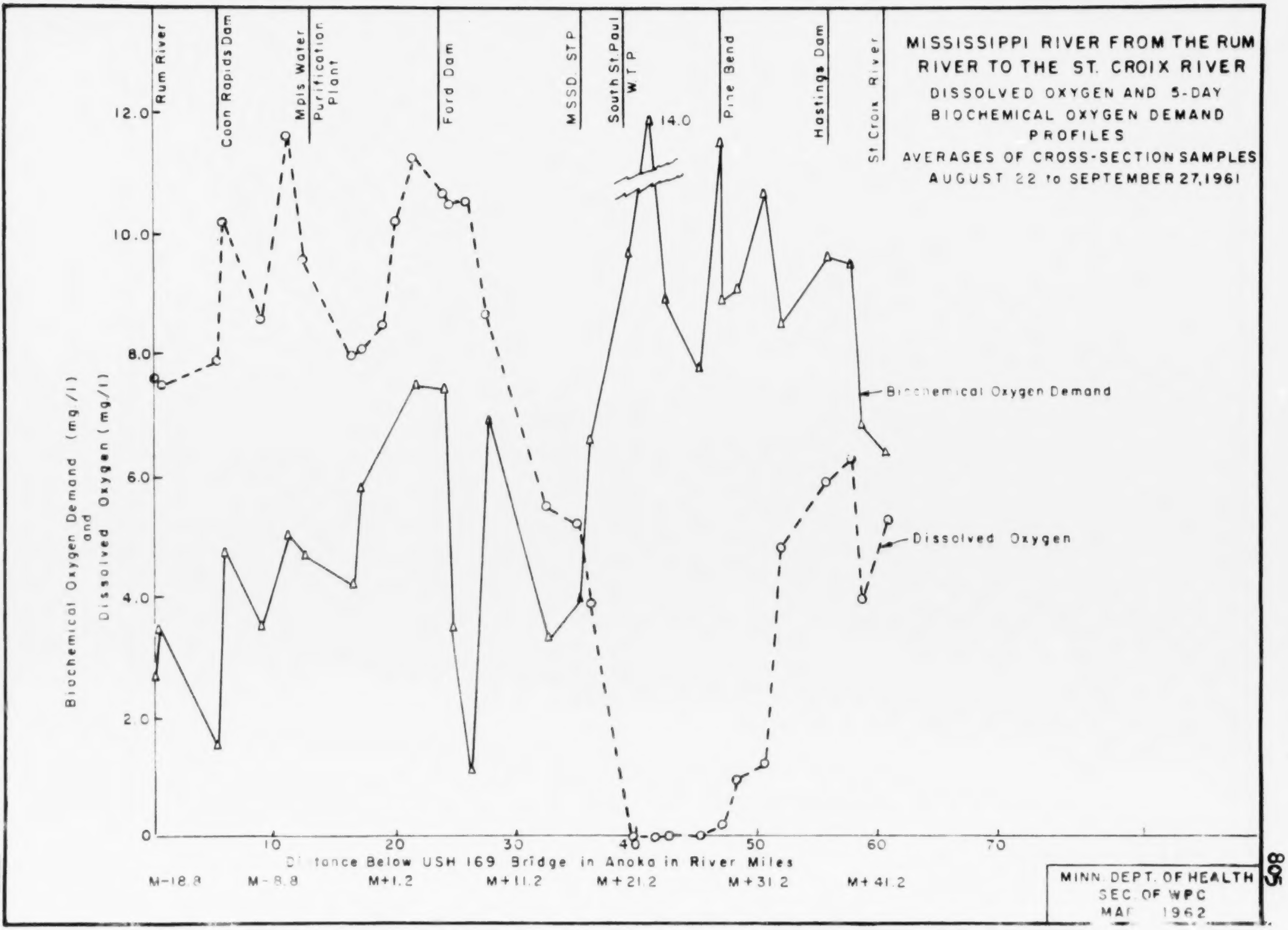


MINN. DEPT. OF HEALTH
SEC. OF W.P.C.
March 1962

MISSISSIPPI RIVER FROM THE RUM RIVER TO THE ST. CROIX RIVER

DISSOLVED OXYGEN AND 5-DAY BIOCHEMICAL OXYGEN DEMAND PROFILES

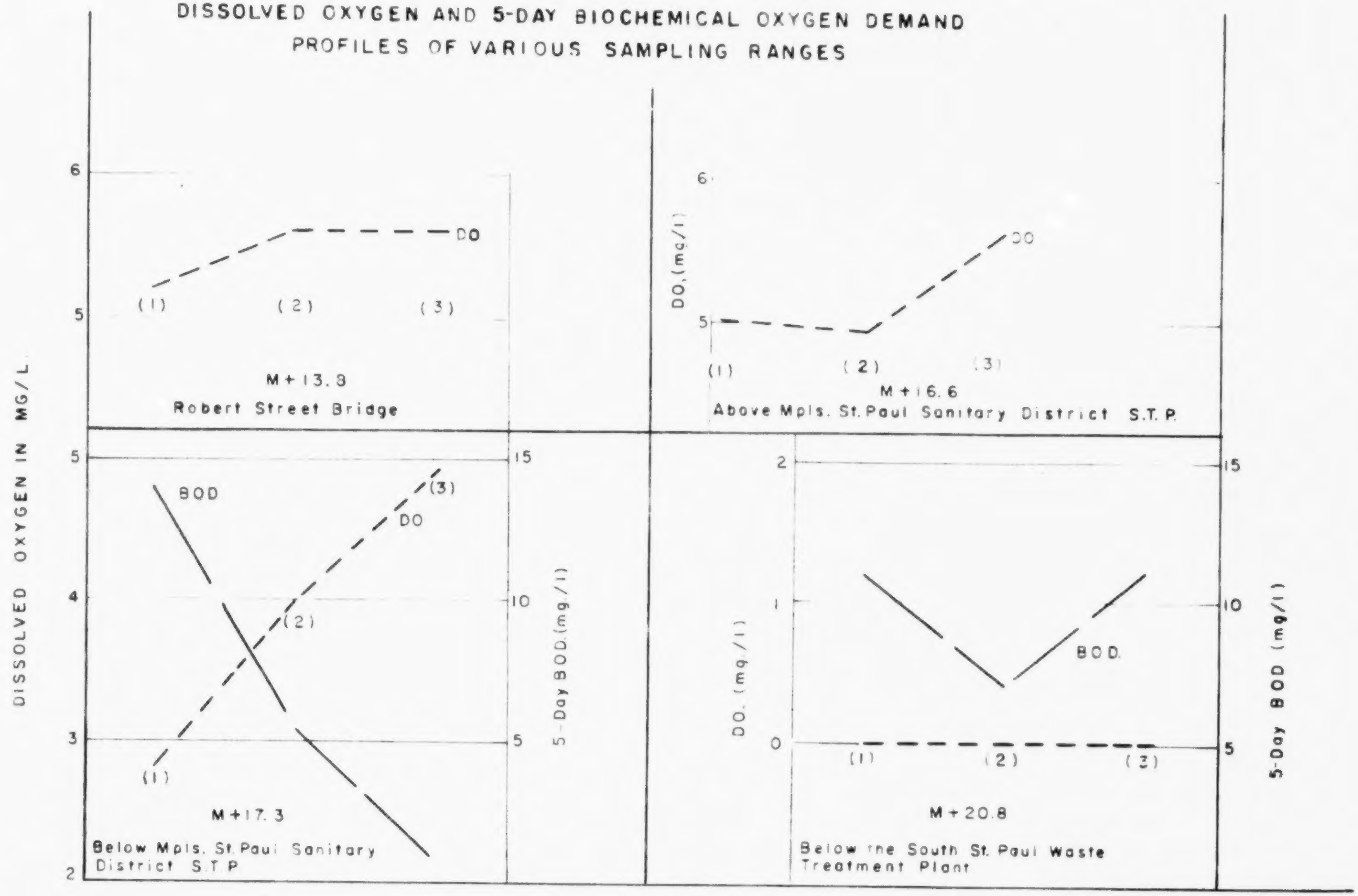
AVERAGES OF CROSS-SECTION SAMPLES
AUGUST 22 to SEPTEMBER 27,1961



MINN. DEPT. OF HEALTH
SEC. OF WPC
MAR 1962

FIG. XIX

MISSISSIPPI RIVER SURVEY, 1961
DISSOLVED OXYGEN AND 5-DAY BIOCHEMICAL OXYGEN DEMAND PROFILES OF VARIOUS SAMPLING RANGES



MINN. DEPT. OF HEALTH
SEC. OF WPC
MARCH 1962

FIG II

Photographic material presented at the proceedings has been omitted. Copies are on file with the Minnesota Department of Health.

MINNESOTA DEPARTMENT OF HEALTH

Division of Environmental Sanitation

Section of Water Pollution Control

Mississippi River Survey, 1961

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MINNESOTA DEPARTMENT OF HEALTH

Division of Environmental Sanitation

Section of Water Pollution Control

Appendix C

Memorandum on the Tributaries to the Main Stem of the Mississippi River in the Metropolitan Area

May, 1962

Rum River

All of the sources of direct discharge of raw sewage have provided or are making progress toward construction of treatment facilities. Cambridge and Onamia constructed plants in 1959 and 1952, respectively. Milaca and Princeton put raw sewage stabilization ponds into operation in 1961. Preliminary engineering studies on the sewage treatment needs of Isanti are in progress.

Minimum flow recorded at St. Francis over a 27 year period is 29 cfs (cubic feet per second), with an average of 575 cfs. Data from analysis of 44 routine samples collected over the past several years at Anoka are as follows:

Item	Determinations	Average	Minimum	Maximum
Coliform Group (MPN/100 ml)	44	3,800	200	17,000
DO (mg/1)	44	9.9	6.0	13.9
BOD (mg/1)	44	3.2	0.7	7.5

Elm Creek

Flows through Champlin into the Mississippi River immediately below Anoka. Champlin has no public sanitary sewer and there are no known sources of industrial waste discharge. The area drained is principally farm land.

Coon Creek

Drains the upper part of the Metropolitan Area watershed lying largely northeast, east, and southeast of Anoka; roughly north to Soderville, east to SH 65 and south to Fridley. The watershed is mainly flat, sandy agricultural land and is sparsely populated except for the southern part southeast of Anoka where there are extensive suburban residential areas such as Thompson Park in Coon Rapids. The creek discharges into the Mississippi River a short distance below the Coon Rapids dam at a point about six miles above the Minneapolis water intake and about two miles above the St. Paul pumping station.

There are no known sources of pollution at present except possibly private homes, and little use is made of the creek except for stock watering. Some swimming is done at a small ponded area immediately north of USH 10 in Coon Rapids.

Since 1960, a number of samples have been collect and flow estimates made at a point a short distance above the mouth. The data are as follows:

Item	Determinations	Average	Minimum	Maximu
Flow (cfs)*	4	40	30	6
*1960 data				
Coliform Group (MPN/100 ml)	13	6060	780	24,00
DO (mg/1)	13	9.0	6.4	11.0
BOD (mg/1)	13	3.7	1.8	6.5

Rice Creek

Drains the area northeast of Fridley and discharges into the Mississippi River at a point about one mile below the St. Paul pumping station and about three miles above the Minneapolis water intake. Residential development in the lower part of the watershed is fairly extensive, but there is at present no discharge from a public sanitary sewer system into the creek. New Brighton is the only sewered municipality in the watershed and discharge is to the Minneapolis system via the Twin Cities Arsenal force main.

Several relatively small industries discharge wastes separately within the watershed. These include a refinery and four rendering plants in New Brighton which discharge wastes to Rush Lake and thence to Rice Creek above Long Lake; and one rendering plant in Blaine which discharges wastes to a slough area. These plants provide facilities for removal of oil and grease from the wastes before discharge. A more comprehensive report on an extended survey of Rice Creek is presently being completed by this Department.

A number of water samples have been collected at various stations on Rice Creek in the past several years. The data for the station near the East River Road, a short distance above the mouth, are summarized below:

Item	Determinations	Average	Minimum	Maximum
Flow (cfs)* *1960 data	7	28	4	80
Coliform Group (MPN/100 ml)	13	3425	220	17,000
DO (mg/1)	13	8.2	0.1	18.0
BOD (mg/1)	13	7.4	3.0	15.0

Shingle Creek

Shingle Creek drains an area lying generally northwest of north Minneapolis. The watershed includes most of Brooklyn Park, Maple Grove, Brooklyn Center, Osseo, and parts of Plymouth, New Hope, Crystal, Robbinsdale, and Minneapolis. The area is still mainly rural, but interspersed are substantial residential areas. There are at present no major waste producing industries in the area nor is there any surface discharge from a municipal sanitary sewer system. Some of the municipalities provide sewer service; e.g., Osseo and Robbinsdale, but discharge to the Minneapolis system. The creek is largely undeveloped and little used for recreational purposes at present except for Camden Park in Minneapolis. Preliminary studies are underway for development of new park areas along the creek in Brooklyn Center and Brooklyn Park.

Data for Shingle Creek at the Lyndale Avenue North station are as follows:

Item	Determinations	Average	Minimum	Maximum
Flow (cfs)* *1960 data	5	28	None	120
Coliform Group (MPN/100 ml)	11	509,800	450	5,400,000
DO (mg/1)	11	9.7	6.6	15.2
BOD (mg/1)	11	4.2	1.3	11.0

Bassetts Creek

Bassett's Creek drains an extensive area west of Minneapolis, including the watershed of Medicine Lake. The area drained is largely devoted to residential development and farming, and includes all or part of Golden Valley, Robbinsdale, Crystal, New Hope, St. Louis Park, Plymouth, Medicine Lake and Minnetonka Village. The communities of Golden Valley, St. Louis Park, Crystal, and New Hope provide sewer service and discharge to the Minneapolis system. Plymouth and Minnetonka Village do not have public sanitary sewer systems.

The creek is considered potentially valuable for recreational use because of the growing residential areas near it, but at present it is largely undeveloped for recreational purposes except for the section which flows through Wirth Park in Minneapolis. Most of the creek through Minneapolis is not accessible since it has been confined in a storm sewer. There are no known major sources of discharge of sewage or industrial wastes either in Minneapolis or in the suburbs.

Sampling data for Bassetts Creek at a station just above the mouth, near the Plymouth Avenue bridge, are summarized as follows:

Item	Determinations	Average	Minimum	Maximum
Flow (cfs)* *1960 data	4	116	4	250
Coliform Group (MPN/100 ml)	13	866,900	7,900	3,500,000
DO (mg/1)	12	6.6	3.8	9.3
BOD (mg/1)	13	12.7	2.5	26

Minnehaha Creek

Minnehaha Creek serves as the outlet of Lake Minnetonka and also drains an extensive area between Lake Minnetonka and the Mississippi River. The drainage area lies due west of Minneapolis and includes all or part of the adjacent suburbs of Morningside, St. Louis Park, Richfield, and Edina, as well as Hopkins and a large number of other communities farther removed. The watershed between Lake Minnetonka and Minneapolis is an attractive, rolling, wooded area and has been substantially developed for residential purposes. The Lake Minnetonka watershed proper is not specifically included in this discussion as such since reports are available on special studies made in recent years in that area.

All of the municipalities named above provide sewer service and discharge to the Minneapolis system. None of the other communities in the watershed, but farther removed, provide sewer service at present, but several have engineering studies or plans in progress. There are no major, separate industrial outlets to Minnehaha Creek either in the suburbs or in Minneapolis and so far as is known, there are no major sources of pollution of the creek at this time. The areas immediately adjacent to the creek have been utilized for residential purposes wherever possible except for some particularly low, swampy areas which are mainly in the westernmost suburbs. The eastern part of the creek is highly prized as a recreational asset since it flows through or nearby a number of lakes in the residential area of south Minneapolis and flows through Minnehaha Park with its famed Minnehaha Falls.

A number of samples have been obtained at a station just above the mouth in Minnehaha Park, but on several occasions no sample could be collected because of little or no flow. The analytical data are summarized, as follows, without regard to those periods when no flow was found:

Item	Determinations	Average	Minimum	Maximum
Coliform Group (MPN/100 ml)	8	22,400	1100	160,000
DO (mg/1)	8	9.0	5.9	11.5
BOD (mg/1)	8	5.1	3.3	8.3

Minnesota River

There is at present only one source of raw sewage on the lower river below the Carver Rapids, i.e., at Chaska. The Chaska Village Council, however, has authorized preparation of final plans and specifications for a secondary sewage treatment plant.

Recent construction includes treatment plants to serve the Cedar Grove development and the Owens-Illinois Glass Company plant in Valley Industrial Park east of Shakopee. A lime sludge pond and aeration flume are provided at the American Crystal Sugar Company near Chaska, and studies are in progress on further improvements. The other major industries such as Rahr Malting Company in Shakopee, Cargill, Inc. in Savage, and the Black Dog plant of Northern States Power Company are either served by separate waste disposal facilities or plans provide for ultimate diversion of the waste to a municipal sewage treatment plant.

This section of the Minnesota River is presently being used mainly for navigation and other purposes connected with the industries on the lower river. Such use is expected to expand substantially in the near future if the projected nine foot channel improvement up to the Carver Rapids is authorized by Congress as anticipated. Development for recreational purposes, mainly in connection with pleasure boating, has begun and considerably more is in prospect, particularly in regard to use of lands near Fort Snelling for park purposes to serve the Metropolitan Area.

The lower river carries a substantial amount of sewage and wastes which are discharged from the communities and industries on the lower river with only primary or no treatment, and at times the capacity of the river to assimilate the waste load has been overtaxed. The flow of the river is quite variable and may be seriously reduced at times such that oxygen depletion may occur, particularly in late summer and winter. The river has been opened for promiscuous fishing in the winter on several occasions by the Department of Conservation.

Water samples are collected routinely in the river below Shakopee. The data for the period 1952 to the present are summarized as follows:

County Road 18 Bridge

Item	Determinations	Average	Minimum	Maximum
Coliform Group (MPN/100 ml)	48	51,800	330	540,000
DO (mg/1)	48	7.2	0.4	20
BOD (mg/1)	48	5.7	1.8	12

Cedar Avenue Bridge

Item	Determinations	Average	Minimum	Maximum
Coliform Group (MPN/100 ml)	4	11,200	2600	22,000
DO (mg/1)	4	8.4	4.5	10.2
BOD (mg/1)	4	7.7	3.3	14

St. Croix River

There are no sources of raw sewage to the lower portion of the St. Croix River, i.e., from Taylors Falls to the mouth.

Recent treatment plant construction includes Stillwater which provided primary treatment in 1960. Other sewage treatment plants are located at Taylors Falls and Bayport, which also receives sewage from the Minnesota State Prison.

The smaller communities along the lower portion of the St. Croix, including Afton, Lakeland Shores, St. Mary's Point, Lake St. Croix Beach and Marine on the St. Croix, do not have public sanitary sewer systems.

The lower portion of the river including Lake St. Croix is an area used heavily for such recreational purposes as boating, fishing, water skiing, and bathing.

Water samples are collected routinely from the Bridge on USH 10 at Prescott. The data for the period 1953 to date are summarized as follows:

Item	Determinations	Mean	Minimum	Maximum
Coliform Group (MPN/100 ml)	57	285	< 20	1300
DO (mg/1)	58	8.8	4.2	14.1
BOD (mg/1)	58	2.8	0.3	6.8

< Means less than.

Appendix D

A Statement to the Water Pollution Control Commission in connection with a hearing on the pollution and on the classification and adoption of standards therefore, of the Mississippi River between the Rum River and the St. Croix River, May 28, 1962

Minnesota Department of Conservation
Division of Game and Fish
Section of Research and Planning

Information on Fish in the Mississippi River from the Mouth of the Rum River to the Mouth of the St. Croix River

The sections of the Mississippi River from the Rum River to the Upper Lock and Dam of St. Anthony Falls, from the Upper Lock and Dam of St. Anthony Falls to the outfall of the present Minneapolis-St. Paul Sanitary District sewage disposal plant, and from the outfall of the present Minneapolis-St. Paul Sanitary District sewage disposal plant to the mouth of the St. Croix River have attracted some attention as fishing waters in recent years. Game fish are present and some fishing both sport and commercial for rough fish is done in one or more of these sections of the River.

Fish Species Present

Species of fish known to occur in the Mississippi River between the Rum River and the St. Croix River are shown in an appended list. Eleven species of game fish including walleye pike, northern pike, largemouth and smallmouth bass and panfish and thirteen species of roughfish are recorded. The list is not assumed to be a complete list of all species present in this stretch of the river. The species listed, however, are fish expected to be present in a large warm-water stream.

The abundance of fish in these sections of the Mississippi River is indicated only by limited information obtained from (1) three stations in the Upper Section between the Rum River and a point 3 miles below the Coon Rapids dam sampled in 1960 in an electro-fishing survey of the Mississippi River between the 3-mile point below Coon Rapids Dam and Elk River[1/] (1/ Electro-fishing survey of the Upper Mississippi River near Elk River, Minnesota. Section of Research and Planning, Rept., Aug., 1960.) and (2) a test netting survey in 1956 of the fish population in a portion of the Lower Section known as Spring Lake located south of the main channel a few miles above lock and dam No. 2[2/]. (2/ Wildlife and Recreational Values of Spring Lake, Dakota County and possible effect of ammonia plant wastes upon them. Section of Research and Planning, Report, Nov., 1956.) The fishery survey in 1960 indicated at least fair populations of bluegills and smallmouth bass and therefore suitable habitat for these species at that time in the areas sampled in the upper portion of the section from the Rum River to St. Anthony Falls. The 1956 survey of Spring Lake showed at that time that game fish were less than half as abundant in Spring Lake as in Pool 3 above Red Wing and that rough fish were about equal in abundance in the two areas. Newness of the electro-fishing technique, uniqueness of the Mississippi River within and above the Twin Cities with respect to other fish waters in Minnesota and the limited scope of the data do not allow comparisons with other waters.

Fishing

Information on use of the Mississippi River between the Rum and the St. Croix Rivers for sport fishing is available in the form of letters from anglers, notes from telephone conversations, and press releases in the files of the Section of Research and Planning. These include accounts of satisfactory walleye pike and smallmouth bass fishing within and above Minneapolis and St. Paul and a few reports of crappie catches below Pigs Eye Island in backwater areas near Newport and near Grey Cloud Island. Fishing success for walleye pike, northern pike and catfish in Spring Lake was reported in 1956 to be low and to have declined over the previous 15 years. Off-flavor of the fish was mentioned with most reports of game fish catches made in the lower section between the present Sanitary District Sewage disposal plant and Lock and Dam No. 2 at Hastings.

Commercial seining for rough fish has been carried out in the Spring Lake area of the lower section since at least 1925. From July 1, 1961, to April 30, 1962, 115,840 pounds of fish mostly carp were caught, and in the approximately five years from July 1, 1957 to April 30, 1962, 1,049,292 pounds of rough fish have been caught in Spring Lake. This compares with approximately 47,747,155 pounds of rough fish taken in the State as a whole for the same period.

The Mississippi River between the Rum River and the St. Croix River and throughout its length upstream from the Rum River is little used by fishermen compared to other fishing waters in Minnesota at the present time. It is probable, however, that the Mississippi River throughout its length above the Rum River and between the Rum River and St. Croix River will be used more by fishermen in the future if the human population increases according to preductions and provided present stream conditions with respect to fish life can be improved or kept the same.

Effect of proposed classification and standards

It appears likely the classification and standards as proposed for the three sections of the Mississippi River between the Rum and the St. Croix Rivers will allow no further deterioration of conditions for fish in these sections of the stream and may result in some improvement, particularly if there is no significant change toward lower flows in the long term pattern of stream flow in these sections of the river. In the Mississippi River immediately below the mouth of the St. Croix River it appears, as in the past, that improvement of conditions for fish will be dependent primarily upon adequate dilution of the Mississippi River by water from the St. Croix River.

Bernard R. Jones
Biological Services Unit
Section of Research and Planning

Approved:

John B. Moyle, Supervisor
Section of Research and Planning

Species of Fish Recorded from the Mississippi River Between the Rum River and St. Croix River

Game Fish	Rough Fish
Walleye pike	Carp
Northern pike	Common sucker
Rockbass	Black bullhead
Bluegill	Yellow bullhead
Black crappie	Silver redhorse
Pumpkinseed sunfish	Northern redhorse
Largemouth bass	Perch
Smallmouth bass	Buffalofish
Catfish	Dogfish (Lower section)
Sauger	Shortnose gar (lower section)
Green Sunfish	Gizzard shad (lower section)
	River sucker (lower section)
	Sheepshead (lower section)

U

Appendix E

Revised 9/1/59

MINNEAPOLIS-SAINT PAUL SANITARY DISTRICT

INSPECTION OF FORMER SEWER OUTLETS IN MINNEAPOLIS

July 20, 1961

On the above date an inspection of former sewer outlets into the Mississippi River was made by the Sanitary District. The outlet locations and discharge conditions are tabulated below.

Outlet Location	Discharge Condition	Outlet Location	Discharge Location
West Bank			
Camden	No Flow	Franklin	(Submerged Outlet)
38th Ave. N.	No Flow	26th Street	No Flow
33rd Ave. N.	Lt. Flow - Clean	Lake Street	Lt. Flow
26th Ave. N.	No Flow	38th Street	No Flow
21st Ave. N.	Lt. Flow - Clean	Minnehaha	Large Opening - Lt. Trickle Small Opening - Heavy Sewage Disch.
Broadway	Lt. Flow - Sewage - Lt. Oil Film	East Bank	
14th Ave. N.	No Flow	Columbia Hts. Line	Lt. Flow - Clean
Bassetts Creek	Heavy Flow, Oil Slick	31st Ave. N.E.	Not Vis. - Dredging
1st Ave. N.	No Flow	3rd Ave. N.E.	No Flow
8th Ave. S.	No Flow - No Vapor - Discoloration	10th Ave. S.E.	Heavy Flow - Sewage - Vapor
11th Ave. S.	No Flow	Oak Street	Lt. Trickle - Clean
2nd St. S. (River Terminal Coal Dock)		27th Ave. S.E.	(Submerged Outlet)
	—	Cecil St. S.E.	No Flow
4th St. S.	Lt. Flow Sewage) Oil film along W. Bank	Bridal Veil Falls	Clear Flow - No Odor
5th St. S.	Lt. Flow Sewage		
Opening Above Mpls. Headhouse	Lt. Flow		
Opening Below Mpls. Headhouse	Lt. Flow		
33rd St. S.	No Flow		

Inspected by: Paul - Carl - Chuck Keister

NOTE: Main St. Sewer will be checked periodically by Minneapolis Sewer Department as per agreement with Flour Mills Organizations.
Rained Previous Evening and a.m.

- Copied from Minneapolis-St. Paul Sanitary District Form [illegible]

Revised 5/1/58

MINNEAPOLIS-SAINT PAUL SANITARY DISTRICT

INSPECTION OF FORMER SEWER OUTLETS IN SAINT PAUL

July 20, 1961

On the above date an inspection of former sewer outlets into the Mississippi River was made by the Sanitary District. The outlet locations and discharge conditions are tabulated below.

Outlet Location	Discharge Condition	Outlet Location	Discharge Condition
Eustis Ave. (Somerville)	No Flow	Minnesota	No Flow
Otis Ave.	No Flow	Cedar	Lt. Flow - Sewage
Marshall Ave.	No Flow	Robert	No Flow
Portland Ave.	No Flow	Eaton	No Flow
Princeton Ave.	No Flow	Jackson	No Flow
Jefferson Ave.	No Flow	Sibley	No Flow
Randolph W.	No Flow	Broadway	Lt. Flow Sewage
Scheffer	No Flow	Moses	No Flow
Otto	H. Flow - Clean	Custer	No Flow
Davern	Heavy Sewage Flow	Arthur	Lt. Sewage Flow
Otto E.	No Flow	Robie	Heavy Sewage Flow
Randolph E.	Trickle - Clean	State	Barge Blocking View
Drake	Constr. - No Access	Minnetonka	No Flow
Smith	No Flow	Trout Brook at 4th St.	Lt. Flow - Clean
Sherman	No Flow	Trout Brook at River	No Flow
Eagle	H. Flow - Sewage	Urban	No Flow
Market Street	No Flow	Belt Line	No Flow
St. Peter	Lt. Flow - Clean		

Inspected by: Paul - Carl - Chuck Keister

Rained Previous Evening and a.m.

Copied from Minneapolis-St. Paul Sanitary District Form L-13.

Appendix F

MINNEAPOLIS-SAINT PAUL SANITARY DISTRICT

SUMMER PERIODS WHEN RIVER D.O. WAS BELOW MINIMUM STANDARDS*

	YEAR			
	1958	1959	1960	1961
D.O. less than 2 ppm	79 days (June 25 & 27, July 2-3, 17 thru Sept. 4, Sept. 17 & 26, Oct. 1-2, 8-30)	43 days (July 1, 22 thru Sept. 1, Sept. 10)	42 days (July 27-Sept. 7)	134 days (June 7-October 19)
D.O., less than 1 ppm	47 days (July 2 & 3, 23 thru Sept. 4, Oct. 2 & 23)	36 days (July 22 thru Aug. 27)	35 days (July 27 thru Aug. 31)	92 days (June 22 to Sept. 21, October 19)
D.O. zero or near zero ppm	45 days (July 2 & 3, 25 thru Sept. 4, Oct. 2 & 23)	30 days (July 28 thru Aug. 27)	21 days (August 3-24)	77 days (July 6 to Sept. 21)
River Flow, cfs (approx. avg.)	4000	3500	3850	3750
River Temp., °F. (approx. avg.)	78	78	76	72

*MSSD Standards (1934 Report)

Maintain 2 ppm D.O. or more 90% of time during critical summer months.
Maintain 1 ppm D.O. or more during extreme minimum monthly river discharges.
Maintain a trace of D.O. during extreme minimum 5-day river discharges.

Copies from Minneapolis-St. Paul Sanitary District Report of 11-27-61, K. L. Mick

EXHIBIT XVII

MINNESOTA DEPARTMENT OF HEALTH
Division of Environmental Sanitation
Section of Water Pollution Control

Oil Pollution of Minnesota and Mississippi Rivers During the Winter of 1962 and Spring of 1963

April 17, 1963

GENERAL

The purpose of this memorandum is to provide information regarding two substantial oil losses which occurred during the winter of 1962-63. The losses involved considerable quantities of petroleum oil from the Richards Oil Company near Savage in Scott County and crude soybean oil from the Honeymead Products Company in Mankato. The prolonged presence of large quantities of oil on the Minnesota and Mississippi Rivers recently has given rise to a considerable number of complaints concerning the nuisance created, and has caused an extensive kill of ducks and some other wildlife.

Both losses occurred during the winter months and were caused by mechanical failure of storage tanks or pipelines under extremes of low temperatures or temperature changes. Neither loss was deliberate, but it is probable that the losses could have been avoided if adequate confinement structures or other suitable facilities had been provided.

The following is a general summary of the activities of this Department which provided the staff for the Water Pollution Control Commission in the handling of this episode. It does not include a discussion of the activities supervised by the Department of Conservation or other agencies. Analytical data are contained in Appendix 1.

Richards Oil Company, Savage

The loss of oil reportedly occurred before December 31, 1962 (possibly on December 8), because of three thermal contraction breaks in a long pipeline which permitted an estimated 1,000,000 gallons of a low viscosity cutting oil to flow from a large storage tank into a diked containment area. The containment area, however, did not prevent the oil from reaching the Minnesota River because of the unfortunate circumstance that open culverts had been installed through the dikes to drain surface water.

Most of the oil probably reached the river immediately after the loss occurred.

Information concerning the oil spill was first brought to the attention of this Department on January 14, 1963, by B. R. Jones, Supervisor of Biological Services, Minnesota Department of Conservation. The matter was investigated by R. D. Miller, Assistant Public Health Engineer of this Section, on January 22. Because of a very recent snowfall, the only evidence of an oil spill visible at the time was under the overhanging end of a barge moored at the company dock on the Minnesota River. The extent of the oil loss and the specific cause were not revealed by the plant operator at the time, and the investigator was led to believe that the oil spill was of a minor nature and attributable to faulty unloading operations or a leaking barge. Verbal recommendations were made at the time that the company investigate thoroughly the cause of the oil spill and provide safeguards for controlling future incidents. These were later confirmed in writing in a letter dated January 31, in which the company was also requested to advise this Department promptly of the results of the investigation and preventive measures proposed. No reply was received.

When the spring thaw in late March revealed the oil lying on the river ice and it began to be carried down the Minnesota River, the Department received many individual complaints. A second investigation was made on March 14 by G. R. Koonce, Assistant Public Health Engineer of this Section, and the representatives of the company again repeated substantially the same account of the episode as given in January. There was oil visible on the ice of the river at Port Richards at this time and the company was told to take all necessary measures to prevent further losses.

As the Minnesota River ice disappeared, it became evident that oil was continuing to flow from company property into the river, and a third investigation was made on March 18 by Mr. Koonce. The true volume and circumstances of the oil spill were revealed at this time; although not much oil was being carried to the river by surface drainage from the property. The company was again admonished and requested to watch for oil going to the river and take additional measures preventing further oil losses in order to minimize adverse effects on the river.

The company apparently did nothing about this situation and as the volume of the spring run-off increased, residual oil entrapped on the property again flowed to the river. On March 27, a joint investigation was made with a representative of the U. S. Army Corps of Engineers, and Mr. M. Richards was told to take immediate action to prevent oil from going to the river. A visit was made on March 28 and as yet no work had been done toward this end. r. Koonce then directed Mr. B. Richards to immediately seal the culvert which was carrying a great quantity of oil to the ditch and this was done. Later on the same day a dam and baffle were constructed in the ditch to stop all further flow of oil into the river.

On April 1 a conference was held with Mr. Richards in the office of Lyle H. Smith, Chief of the Section of Water Pollution Control. A general outline of remedial possibilities was presented to Mr. Richards which included the continued temporary ponding of the water and oily wastes in the ditch and retention of oil by a baffle, although this meant flooding of a neighbor's property. An alternate proposal was made to provide a permanent facility to contain and skim the wastes on his own property.

It was requested that a sump be constructed to skim the impounded oil, which had not yet been done, and permission was granted on a temporary basis to use emulsifiers on the oil that probably could not be held and would, therefore, discharge to the river. This action was concurred in by the U. S. Corps of Engineers. It was felt that the widespread use of emulsifiers might cause a fish kill and their indiscriminate use was discouraged. Use of emulsifiers on oil in the imponded area was not recommended because this would result in more oil being carried to the river.

Mr. Richards on April 3 informed the Department that Department personnel would in the future be barred from his property. The matter was referred to the Commission's legal adviser who discussed it with Mr. Richards' lawyer. Mrs. Richards later advised the Department that the company would cooperate and that she was now in charge because Mr. Richards was ill and unable to handle business affairs.

Honeymead Products Company, Mankato

Dean Hahn, Sanitarian of the Mankato district office of this Department, notified this Section by telephone late in the afternoon of January 23 that a tank had ruptured at the Honeymead plant earlier that day, spilling some 2-3 million gallons of crude soybean oil. Arrangements were made immediately for a field investigation on the next day.

On the morning of January 24, a phone call from a newspaper reporter was received to the effect that the City of Mankato, which was assisting in cleaning the residential area flooded by the oil, was preparing to dump truckloads of the spilled oil into the Blue Earth River as a disposal method. The city manager was immediately notified by phone that this method of disposal was unsatisfactory and should be discontinued at once. A field investigation by

R. D. Miller, Assistant Public Health Engineer of the Section, later on the day of January 24 confirmed that the practice had been discontinued. It was estimated that in total about 1/2 of the spilled oil had reached the Blue Earth River at a point immediately above the confluence with the Minnesota River.

Verbal recommendations were made to the company and city concerning the removal of the spilled oil from the river surface and the area and its ultimate disposal. One of the recommendations, later confirmed by letter, was for the responsible agents of the company and the city to review the selection of an ultimate disposal site with personnel of the Mankato district office. These recommendations were confirmed by letters addressed to the company and the city dated January 25. The specific causes of the tank failure have not yet been ascertained.

The obvious presence of soybean oil on the Minnesota and Mississippi Rivers and requests by the U. S. Corps of Engineers prompted a joint follow-up investigation of the Honeymead oil problem at Mankato on March 28. At that time, it was apparent that most of the oil which reached the Blue Earth River had either been salvaged or had been carried downstream by the spring flush. Two other significant sources of soybean oil were found at this time. One was a dump area near the main plant and the other a disposal pit in a ravine about two miles east of Rapidan. The latter had been utilized for dumping of oil removed from the spill area. Oil from both was draining into the nearby rivers.

There had been no attempt by either the company or the city to review the selection of such dump sites with personnel of the Mankato office as requested in the letter of January 25. The company had originally provided a small earth dike in the ravine to stop drainage to the LeSueur River which is tributary to the Blue Earth River, but the dike had recently been overtopped and washed away by accumulated snow melt water and oil.

Verbal recommendations were made at this time for the company to take immediate emergency action to stop the flow of oil from both places to the streams. It was suggested that the dump area near the main plant be diked off immediately and that the oily materials be removed to a more suitable disposal site. Recommendations for action at the ravine site included rebuilding of the dam as an emergency expedient, diversion of surface drainage from the upper end of the ravine, and ultimate abandonment of the dump after rodent eradication and covering of the waste with an adequate layer of earth.

Subsequently, phone calls to this Department on March 29 and April 2 from an official of the Honeymead

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indicated that on March 29 action had been taken to stop the flow of oil from both sources and that on April 2 work was progressing on permanent corrective measures. The Honeymead problem areas were again checked on April 5, and it was found that the company had carried out all the recommendations made on March 28 except abandonment of the pit.

WATER POLLUTION CONTROL COMMISSION

The Commission was informed of this situation in detail at the meeting held in Minneapolis, State Board of Health Building, on March 28.

After considerable discussion it became apparent that an emergency order could not be issued under the circumstances. A motion was passed, however, urging that all possible legal action be taken by the Commission's legal counsel to stop further oil discharges and prosecute those responsible if the facts warrant. The motion is as follows:

> "that Mr. C. S. Wilson be instructed to contact the County Attorney of Scott County and offer the assistance of the Water Pollution Control Commission to investigate the facts and prevent further pollution of the Minnesota River by Richards Oil Company and take such other action as may now be

presently appropriate."

JOINT FIELD STUDIES WITH THE UNITED STATES PUBLIC HEALTH SERVICE

The effect of the oil on the Blue Earth, Minnesota, and Mississippi Rivers was investigated by a field crew during the third and fourth weeks of April. Lowell Keup and Kenneth Mackenthun, Biologists, and Carl Hirth, Chemist, were the members of the U. S. Public Health Service field crew. Gerald S. Allen, Associate Public Health Engineer, represented this Department.

The condition of the Blue Earth River and the Minnesota River in the Mankato area was observed on April 16. The Honeymead plant was also visited at this time. A number of bottom mud samples were collected about one-quarter mile below the plant on the Blue Earth River. There was evidence of oil having mixed with the sand on the beach in this area, making a hard crust about three feet above the water level. There was no evidence of excessive amounts of soybean oil in the water.

The dump area, located near the LeSueur River about two miles east of Rapidan, was also visited at the same time. Considerable oil, apparently soybean oil, was impounded in low areas of the river bottom near the LeSueur

River shoreline. A varnish-like covering was noted on the willows at the banks of the river, indicating that oil had escaped into the river during the spring run-off period. The oil which was present in the low areas could enter the river during periods of heavy run-off, if further preventive measures are not taken.

The condition of the Minnesota River was observed from the U. S. Highway 169 bridge at LeSueur, the U. S. Highway 169 bridge at Shakopee and State Highway 36 bridge at Bloomington, as well as at Mankato. Some oil was evident at most of these places.

The condition of the Mississippi River in the area of Red Wing was investigated on April 17. Some oil scum was confined in the Red Wing municipal boat harbor at this time. The scum had a milky white appearance, with some brown film on the surface. Stringy, taffy-like oil material had accumulated along the shore. According to the State Game Warden, Ronald Shager, the entire harbor had been covered with a thick scum two or three days earlier. The wind had apparently blown much of this material back into the river. All of the vegetation on the banks of the river in this area had a dark marking about two feet above the present water level. Markings on the vegetation were also observed on both sides of Upper Lake Pepin.

A number of white balls, apparently soybean oil, were observed on or near the surface in the upper part of Lake Pepin on April 17. They generally varied in diameter from one-eighth inch to two inches. These balls seemed to be working toward the shore and breaking up, forming long, white stringy material. This stringy, tough material had collected on the shore at Wacouta. Pools of milky material covered with a brown scum were noted in the low areas at this beach. A hard, varnish-like crust was also observed on the beach. Much of the stringy material had become tough and coated with a thin, brown film. Approximately a half dozen dead ducks were observed in about 150 yards of shoreline at the Wacouta beach. They were covered with the oily material. The condition of the shoreline on the Wisconsin side of the lake, across from Wacouta, was much the same as noted on the Minnesota shore.

A number of bottom samples were collected in the Red Wing boat harbor and in Upper Lake Pepin near Bay City, Wisconsin, and Wacouta, Minnesota, on Friday, April 19. White material, apparently soybean oil, was evident in many of these samples, particularly in the samples collected near the end of the Red Wing dock about 100 yards from the shore. Some evidence of oil was also noted in the bottom samples collected at Wacouta and Bay City; however, not in the quantity observed at Red Wing.

Public Health Service personnel collected bottom samples and observed conditions in Sturgeon Lake abo , Red Wing on April 22. Some stringy material had accumulated on the shoreline; however, little oil was noted in the bottom samples collected in the lake.

On April 24, Mr. Allen and Robert G. Eckart, Public Health Engineering Aide of this Department, investigated shoreline conditions on the Mississippi River below Red Wing to determine the extent of oil accumulation on the beaches.

A limited amount of small, stringy material was observed on the beach at the Boy Scout Camp on Central Point, located about two miles northwest of Lake City. The oil was not mixed with the sand and could be easily removed from the beach. No oily material was observed downstream from this point on the Minnesota shore.

Large quantities of oily material had collected on the beaches at Bay City, Wisconsin, and mixed with the sand, causing a hard crust to develop about three feet above the water level. The oil not only collected on the beach surface, but had also mixed with the sand for some depth. The shoreline, including a municipal beach, will be unsuitable for use this summer. White, sticky material had accumulated along the bottom in the water near shore, along about 100 yards of beach, making it almost impossible to land a boat in that area.

A small amount of white, stringy material was blown onto the beach at Maiden Rock, as well as at Bay City, at the time of the investigation. It appeared that this material was the white oil balls that may previously have settled to the bottom of the lake.

Oil had also collected and dried on the beaches at Maiden Rock, Wisconsin; however, not in the quantities noted at Bay City. Still less material was observed on the beaches at Stockholm, Wisconsin. Oil mixed with debris was in evidence at Pepin, Wisconin, and appeared to have been washed in recently from other areas upstream. No oily material was observed below Pepin on the Wisconsin shore. The lock master at Lock and Dam No. 4 in Alma, Wisconsin, reported that no white, oily material, or excessive oil slick had been seen in the river in that area this spring.

In the Mississippi River and Lake Pepin area, it appeared that the shoreline near Bay City, Wisconsin, and Wacouta, Minnesota, received the major quantity of oily material. Apparently the ice in Lake Pepin confined the oil to the upper lake in early April. The effect of the oil on the shoreline appears to have extended down into Lake Pepin to at least Maiden Rock, Wisconsin. It appeared that more of this material had accumulated on the Wisconsin than on the Minnesota shore. Some of the oily debris was seen as far down the stream as Pepin, Wisconsin.

Additional debris can be expected to continue to wash downstream in the future; however, the nuisance conditions caused by this latter action are unlikely to be severe. Results of the technical studies will be reported upon by the U. S. Public Health Service.

CONCLUSIONS

1. Mr. Richards failed to take any action until the Department virtually engineered the temporary project for him. He did not cooperate with the Department at all in the early stages when preventive measures would have been more effective, as shown by his failure to give the investigators the facts, and finally forbade access to his property or to him except through his lawyer. The company failed to retain professional help and delayed construction of works until forced to proceed by a direct order of the U. S. Corps of Engineers. Plans for permanent facilities are now being prepared by a consulting engineer.

2. The Honeymead Company has been cooperative with the Department in carrying out their recommendations, but there was a lack of responsible supervision of measures taken to dispose of the spilled oil so as to avoid further pollution. It appeared evident also that more vigorous and thorough salvage operations should have been undertaken by

the company to remove all possible oil from the river before the spring flush.

3. The oil losses have had a disastrous effect upon waterfowl, were highly deleterious to riverfront recreational facilities, and have resulted in nationwide publicity.

4. The episode glaringly emphasized that the agency which is primarily responsible for control of pollution in Minnesota, the Water Pollution Control Commission, does not have specific authority to require preventive measures to effectively contain stored non-waste materials, nor does it have authority to require those responsible for a loss of this kind to take necessary clean-up or salvage action unless a public health emergency is created.

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Appendix

MINNESOTA DEPARTMENT OF HEALTH

Division of Environmental Sanitation

Section of Engineering Laboratories

LABORATORY STUDIES OF OIL RECOVERED FROM SAVAGE AND MANKATO SPILLS

Nineteen oil samples have been collected and characterized in this study. The results are summarized in the attached table.

Initially samples were extracted with chloroform. The chloroform and aqueous phases were separated and the chloroform phase filtered through medium porosity paper. Part of the chloroform solution was treated with activated carbon, and both parts were placed on a steam bath to evaporate the chloroform. Infrared studies were made of the oil residue.

This treatment was satisfactory for soybean oil, but the petroleum oil under investigation had volatile aromatic constituents which were mostly removed during treatment. The use of irtran--2 windows makes it possible to handle wet samples in the infrared apparatus and the procedure finally used in preparing samples was simply that of drawing off as dry a portion as possible after the sample had been allowed to stand for several hours. This procedure could be expected to eliminate losses of volatile constituents in the laboratory, but the samples containing petroleum oil were still low in aromatics. Apparently these materials tend to disappear rapidly, possibly by evaporation, from the spilled material.

Oil samples were mechanically removed from the ducks collected in this study and analyzed directly without treatment.

At times, the oil which normally floated on the surface of the river tended to sink. One such sample of oil from the bottom of Lake Pepin (number 6283) was examined and found to be soybean oil. In boiling water, the oil again started to float on the surface, releasing a considerable quantity of sand and dirt as well as water-soaked twigs and leaves. The tendency to sink apparently resulted from the entrapment of this heavy material in the oily mass.

The use of a finely divided material such as diatomaceous earth, which would not readily separate from the oil, had been suggested as a means of causing the oil to sink to the bottom and remain there until decomposed. Laboratory experiments indicated that for pure soybean oil one pound of diatomaceous earth would be required for every four pounds of oil. Less diatomaceous earth would probably be needed in actual use since the oil would already have entrapped some fine clay, etc. The stability of the mixture with time is still being tested.

A BOD (5-day biochemical oxygen demand) study was made of material collected from the beach at Wacouta, Minnesota, in Upper Lake Pepin on April 17. The sample was prepared for the BOD test by macerating 6.4 grams of the solid material with 245 ml (milliliters) of water in a Waring blender. The resulting mixture was then diluted with BOD dilution water in BOD bottles, seeded with river water, and incubated for 5 days at 20° C.

Dilutions which provided useful oxygen depletion data, and the oxygen measurements obtained, were as follows:

Sample Concentration in Laboratory Bottle (mg/l)	Oxygen Depletion (mg/l)	mg of Oxygen consumed per mg of sample
52	4.3	0.08
26	2.7	0.10
10.4	1.4	0.13
5.2	1.0	0.19

The increase in the BOD with greater dilution appears to be attributable to the low solubility of the material. The results indicate a relatively low BOD for organic material. It would not under conditions in the stream or lake exert an oxygen demand as great as obtained in the laboratory, since the sample was thoroughly macerated and mixed before the analysis. The material normally occurs in the river in large pieces and would not expose much surface area to bacterial activity.

It appears that oily material typical of the sample analyzed would not have sufficient oxygen demand to significantly affect the oxygen resources of the river.

SAMPLES COLLECTED AND ANALYZED IN OIL SPILL STUDY

LABORATORY NUMBER	FIELD NUMBER	DATE COLLECTED	LOCATION	SAMPLING POINT AND SOURCE OF SAMPLE	RESULTS SOYBEAN	PETROLEUM
6061	A	3/25/63	Newport	1495 Cedar Lane Newport, Mississippi R.	—	100%
6062	B	3/25/63	Newport	End of 12th St. at Mississippi R.	—	100%
6089	D	3/27/63	Savage	Port Richards, Richards Oil Co., from diked area.	—	100%
6128	E	3/28/63	Hastings	At Hastings dam, Mississippi R.	100%	—
6129	F	3/28/63	Shakopee	Bridge off Highway 169, Minnesota R.	100%	—
6130	G	3/28/63	Rapidan	2 miles east of Rapidan, below junction of LeSueur R. and drainage from Honeymead dump area.	100%	—
6169	1	4/1/63	Dakota County	Southeast part of Spring Lake, from shore of island near main channel	100%	—
6179	2	4/1/63	Pine Bend	From main channel of Mississippi R. opposite N.W. Coop Mills.	100%	—
6171	3	4/1/63	Pine Bend	From shore oil deposit 1 block south of N.W. Coop Mills.	40%	60%
6283	24	4/4/63	Bay City, Wisc.	Oil that settled on bottom of Lake Pepin.	100%	—

SAMPLES COLLECTED AND ANALYZED IN OIL SPILL STUDY

LABORATORY NUMBER	FIELD NUMBER	DATE COLLECTED	LOCATION	SAMPLING POINT AND SOURCE OF SAMPLE	RESULTS SOYBEAN	PETROLEUM
6391	1	3/28/63	Spring Lake	Oil scraped from ducks	100%	—
6392	2	3/28/63	Spring Lake	Oil scraped from ducks	80%-90%	10%-20%
6393	3	3/28/63	Spring Lake	Oil scraped from ducks	90% or more	10% or less
6394	1	3/30/63	Sturgeon Lake	Oil scraped from ducks	100%	—
6395	2	3/30/63	Sturgeon Lake	Oil scraped from ducks	100%	—
6396	3	3/30/63	Sturgeon Lake	Oil scraped from ducks	100%	—
6397	1	4/1/63	Mississippi R. near Red Wing	Oil scraped from ducks	100%	—
6398	2	4/1/63	Mississippi R. near Red Wing	Oil scraped from ducks	100%	—
6399	3	4/1/63	Mississippi R. near Red Wing	Oil scraped from ducks	100%	—

Note: All samples from ducks were collected by Minnesota Department of Conservation personnel.

Appendix ~

MINNESOTA DEPARTMENT OF HEALTH

Division of Environmental Sanitation

Summary of Section of Water Pollution Control Field Activities Regarding Oil Pollution of Minnesota and Mississippi Rivers

January - May, 1963

January 14: Water Pollution Control informed by phone by B. R. Jones of Department of Conservation of oil pollution by Richards Oil Company near Savage.

January 17: Department of Conservation mailed complaints of oil pollution by Richards Oil Company to the Minnesota Department of Health.

January 22: R. D. Miller of the Minnesota Department of Health investigated Richards oil spill and found evidence of oil on ice near the dock area. Verbal recommendations were made.

January 23. D. Hahn of the Mankato District office called and stated 2-3 million gallons of soybean oil escaped from ruptured tank of Honeymead Products Company at Mankato.

January 24: R. D. Miller investigated oil spill of Honeymead at Mankato and made recommendations. Honeymead and city were cleaning oil from area.

January 25: R. D. Miller wrote Honeymead and city about results of investigation of oil spill, no reply received. Recommended disposal measures be taken under supervision of District office.

January 31: R. D. Miller wrote letter to Richards Oil Company concerning the oil spill and indicated safeguards to take. No reply.

March 11: Department of Conservation phoned about oil on Minnesota River at Richards Oil Company at Savage.

March 14: G. R. Koonce investigated, found oil on ice at Port Richards area.

March 15: G. R. Koonce talked to Mr. Richards concerning the spill and was led to believe that spill resulted from unloading of a barge. Recommended certain things to assure higher degree of care in unloading and finding pipeline leaks.

March 18: Department of Conservation telephoned again about Richards oil pollution. G. R. Koonce visited again and discussed circumstances of the spill with company.

March 25: Complaint of oil on the Mississippi River at Newport. G. R. Koonce investigated and found Mississippi River from St. Paul to Newport covered with oil. Letter to Mr. Richards concerning oil spill. Received numerous complaints from individuals concerning the oil.

March 27: G. R. Koonce and C. A. Johannes of this Department and Messrs. Foster and Ryder from U. S. Corps of Engineers investigated oil spill at Richards. Requested immediate construction of retention pond with baffle to skim oil from flow going to river. Truck and shovel moved to site at river.

March 28: G. R. Koonce visited again, had not yet stopped oil flow into the Minnesota River. Mr. M. Richards said they would start today. Advised sealing of culverts to ditch.

G. R. Koonce collected samples of oil on the Mississippi River at Hastings. Petroleum oil went down first and soybean oil began to flow past the Hastings Dam No. 3 on March 27.

R. D. Miller and G. R. Koonce visited Honeymead and found that soybean oil from broken oil barrels at a storage place on their plant site in Mankato was going into the Blue Earth River. Oil from the dump area about two miles east of Rapidan was flowing into the LeSueur River which is a tributary of the Blue Earth River and the Minnesota River.

March 29: George Walker of Honeymead called to inform us that they had diked off and were currently cleaning up the dump in the plant area and were reconstructing the dam with sandbags at the dump area in the ravine about two miles east of Rapidan.

G. R. Koonce, and R. R. Jones of the Department of Conservation, went to Richards. The dam and baffles were installed and were holding back the oil. There was no oil or water going into the river.

March 31: Richards Oil Company burned oil from their land.

April 1: George Walker of Honeymead called to inform us that good progress was being made in controlling oil seepage. He stated that they had stopped the flow of oil to the river on last Friday and were building a larger dam at the foot of the ravine near Rapidan with heavy equipment. He also reported that drainage from field tiles which enters the head of the ravine was being tiled around the dump area.

L. H. Smith, C. A. Johannes, and G. R. Koonce. Mr. Myron Richards visited office and was told that drainage ditch should be cleaned and that he should dike and hold the water on his own property. He was advised to install a sump to catch oil from the baffle.

April 1: G. R. Koonce. Water going over the dam at Richards. Some oil near dam on river side, was advised to skim oil off before it got to river.

G. R. Koonce, and B. R. Jones of the Department of Conservation, checked the Mississippi River from Pine Bend to the outlet of Spring Lake. Found dead fish and ducks and oil on the river.

April 2: G. R. Koonce. Gave permission to Richards Oil Company to use emulsifiers on oil which is in danger of going into the river.

April 3: G. R. Koonce. Mr. Myron Richards called and said the Department of Health was no longer welcome on his property, was very emotional and disturbed about the publicity he received. He said that further contacts should be made through his lawyer.

Chester Wilson, Special Assistant Attorney General, called Richards' attorney and called attention to the right of entry provided Department personnel in the Water Pollution Control Act.

April 4: G. R. Koonce and U. S. Public Health Service officials checked Minnesota and Mississippi

Rivers and found oil slick on Mississippi River at Newport and soybean oil on the Minnesota River in Bloomington at the Cedar Avenue Bridge. At Bay City, Wisconsin, and Hastings, Minnesota, there was putty-like oil on the bottom of the river.

April 5: G. R. Koonce was informed by Mrs. Richards that she is now conducting the business of the company as Mr. Richards is ill, and the company will comply with the Department's recommendations.

April 5: G. R. Koonce visited Richards and suggested that they clean the ditch and dike the water on their own property and construct a sump. They had used the emulsifier on the oil between the baffle and the dike. No oil on the river.

G. R. Koonce visited Honeymead. They had dammed the barrel dump area in the back of their plant and constructed two dams in the ravine at their dump area two miles east of Rapidan. No oil on the Blue Earth or Minnesota Rivers.

April 9: G. R. Koonce. B. Richards called and is going to clean ditch starting next Thursday.

April 12: Good Friday. Conference with officials of U. S. Public Health Service re Governor Rolvaag's request for federal assistance and their

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preliminary investigation. G. R. Koonce also accompanied Hayse Black of Public Health Service on visit to Richards and Honeymead.

April 16: Public Health Service crew arrived and began river survey near Mankato. Accompanied by G. S. Allen of this Section. Governor Rolvaag announced end of emergency and released National Guard.

April 17: Public Health Service crew and G. S. Allen surveying Mississippi River.

April 20: Lyle H. Smith, Chief, Section of Water Pollution Control, and George Koonce visited Richards and found an oil slick going into the river. Called Mr. Richards and Douglas Barr, his consulting engineer.

May 2: G. R. Koonce visited Richards. Another earthen dike had been constructed, but some oil was still going to the river. Also visited Honeymead and found oil on river but no oil going to LeSueur River from diked area.

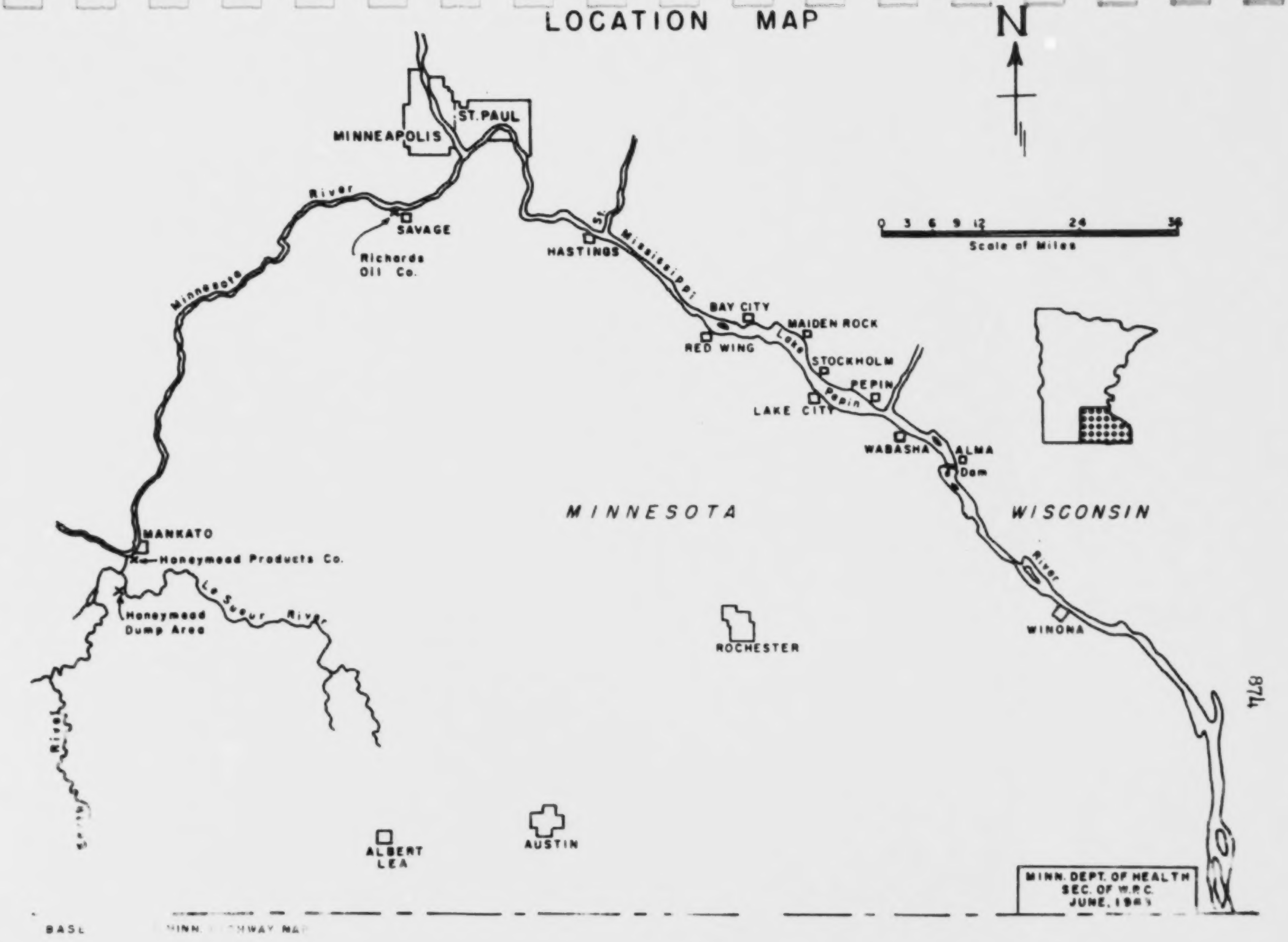
May 13: G. R. Koonce visited Richards. Because of heavy rains, large oil slick was going into the river. Made recommendations for improvements. Preliminary plans for waste disposal facilities reviewed with Douglas Barr.

May 14: G. R. Koonce visited Richards. Found oil slick going into river.

Notes: A considerable number of other activities including conferences with other agencies concerned, telephoning of information in response to inquiries, and gathering of evidence such as sampling of oil and water for laboratory analysis, have also been conducted and are continuing.

Photographic material presented at the proceedings has been omitted. Copies are on file with the Minnesota Department of Health.

LOCATION MAP



WATER QUALITY SAMPLING PROGRAM

a
compilation
of minnesota
sampling
station
records

MINNESOTA LAKES and STREAMS

VOLUME 1
1953-1957

BY THE SECTION OF WATER POLLUTION CONTROL
DIVISION OF ENVIRONMENTAL SANITATION
MINNESOTA DEPARTMENT OF HEALTH

Errata, "Water Quality Sampling Program, Volume 1, 1953-1957"

Page	Items
5	Station BE-63, "Description" should read: "Bridge on CAR 2 which continues east from CAR 136 for ½ mile to the Blue Earth River."
6	Station DM-8.3, "Description" should read: "..south to bridge which crosses the Des Moines River."
7	Station Rc-4, "Description" should read: "Bridge on CAR 4, 3 miles south of Austin."
	Station Ro-12, "Description" should read: "2 miles south of Luverne on U. S. Highway 75 to CAR 21 and east to bridge crossing Rock River."
9	Station St-18, "Description" should read: "Bridge on second undesignated road east and one mile south of Clinton Falls."
	Station NBZ-72, in "Description," change "south" to "east".
74	Under St. Croix River at Taylors Falls, delete all items and insert "April 9, temp. 42, pH 7.4, Coliform Group 780, Turb. 8, DO 12, BOD 3.1."

WATER POLLUTION CONTROL COMMISSION

State of Minnesota

R. H. Putnam, Chairman
Member at Large

Dr. R. L. West, Vice Chairman
Secretary and Executive Officer
State Live Stock Sanitary Board

Dr. R. N. Barr, Secretary
Secretary and Executive Officer
State Board of Health

G. A. Selke
Commissioner of Conservation

B. G. Allen
Commissioner of Agriculture

G. C. Scott
Member at Large

Dr. M. M. Hargraves
Member at Large

H. G. Rogers, Executive Engineer

MINNESOTA DEPARTMENT OF HEALTH
Division of Environmental Sanitation
Section of Water Pollution Control
(Technical and Administrative Agency
for the Commission)

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COLLECTION OF SAMPLES

The water samples were collected by personnel of the Section of Water Pollution Control, by means of a double sampler. The double sampler is constructed to permit a simultaneous collection of three separate samples for dissolved oxygen, bacteriological and chemical analysis. Sampling was usually done from a bridge, or when necessary, from a bank by immersing the sampler to a depth of about one foot in the main flow of the stream.

Whenever possible, the samples obtained at each station were always collected at the same spot and as nearly as possible in the same part of the flow, in order to minimize sampling errors. The samples were preserved by icing and promptly shipped to the laboratory for analysis.

The temperature and p^H of the samples were measured in the field, and a record was also made of pertinent physical conditions at the time of sampling.

MINNESOTA DEPARTMENT OF HEALTH
Division of Environmental Sanitation
Section of Water Pollution Control

WATER QUALITY SAMPLING PROGRAM
Field and Analytical Data
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Cannon River at Welch — Station Ca-13.4

Date	Temp.	pH	Flow (cfs)	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Jan. 21	33	8.2	220	2,300	1.4	11	370	3.2	160	3.8	260	17.0	13	1.4
March 12	38	8.2	469	3,100	4.5	18	390	11.0	160	-	270	18.0	11.9	2.9
April 13	42	8.5	750	1.300	18	35	360	30	110	9.4	200	8.0	12.0	4.7
July 13	69	8.1	405	92,000	220.0	10	620	334	170	48	180	6.0	7.5	3.6
Aug. 27	79	8.7	402	17,000	8.0	30	390	27	110	5.8	218	N.F.	8.2	1.8
Nov. 13	41	8.5	189	2,600	7.0	19	350	11	130	4.0	240	12.0	10.7	4.1

Crow River at Dayton — Station Cr-0

Date	Temp.	pH	Flow* (cfs)	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Jan. 28	32	8.0	110	-	3.5	20	90	2.2	25	4.0	300	9.0	8.2	1.6
March 9	32	7.8	95	170	9.0	4.0	430	4.0	150	1.6	300	7.5	7.5	1.1
April 16	42	-	1940	490	21	38	450	37	140	12.0	180	6.5	12.0	4.6
June 16	75	8.3	1790	3,500	45	-	450	92	81	21	320	1.5	5.4	3.1
July 14	72	8.4	2320	2,300	42	60	430	100	170	19	220	2.5	5.5	3.0
Nov. 12	41	8.6	113	130	8.0	31	410	10	150	5.4	280	7.0	12.5	3.8

Des Moines River at Jackson — Station DM-13.1

Date	Temp.	pH	Flow (cfs)	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Jan. 19	35	7.6	7.8	700,000	17	14	840	18	240	24	320	27	6.7	18.0
March 10	41	7.8	21	20,000	18	15	580	22	190	9.2	270	18	8.4	5.4
April 14	46	8.8	348	9,200	50	27	600	72	140	21	150	8	9.3	6.6
June 18	78	8.4	1670	7,800	46	-	590	90	230	21	170	5.0	6.0	2.5
July 16	78	8.2	449	92,000	60	35	650	81	200	19	170	4.5	7.3	6.9
Dec. 3	38	8.6	14	1,600,000	42	25	550	38	160	18	240	14.0	13.0	14.0

*Gaging station at Rockford

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Les Moines River at Jackson Station DM-14

Date	Temp.	pH	Flow (cfs)	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Jan. 19	33	7.6	7.8	3,300	13	13	780	7.8	220	10	320	15	2.4	1.5
March 10	32	7.8	21	2,200	24	15	380	16.0	100	4.8	180	1.5	11.2	2.1
April 14	46	8.9	348	2,400	37	25	630	70	170	22	150	7	12.1	7.0
June 18	78.5	8.2	1670	7,900	46	-	540	82	210	19	160	4.5	5.8	3.9
July 16	78	8.3	449	4,600	55	35	620	86	190	19	180	5.0	7.2	5.2
Dec. 3	32	8.7	14	790	39	23	560	39	170	18	240	20	17.0	7.3

Lower Mississippi River at Fridley Station LM-1

Date	Temp.	pH	Flow* (cfs)	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Jan. 28	32	7.9	5100	3,300	1.2	20	210	3.0	65	6.8	180	N.F.	7.8	1.8
March 9	34	7.7	4100	3,300	8.0	18	240	4.0	52	2.4	170	N.F.	7.6	0.65
April 16	42	8.2	18700	1,700	20	70	210	24	91	68	110	0.5	11.0	2.2
June 16	72	8.7	18500	4,900	23.0	-	250	42.0	40	18	200	0.5	5.8	2.[illegible]
July 14	72	8.3	16400	54,000	23.0	90	240	35	110	9.2	130	N.F.	6.0	1.2
Nov. 12	42	8.7	5990	3,500	7.0	30	200	7.6	68	4.0	160	N.F.	13.1	3.1

Minnesota River at Shakopee Station Mi-16.6

Date	Temp.	pH	Flow** (cfs)	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Jan. 20	33	7.7	340	6,400	9.0	27	630	4.4	210	7.4	350	1.0	5.7	2.2
March 11	32	7.9	710	17,000	12.0	15.0	640	2.8	200	2.8	320	5.5	6.0	2.3
April 15	44	8.6	6530	9,500	70.0	32.0	760	164	180	28.0	200	1.5	10.5	3.8
June 19	80	8.4	12800	7,900	100.0	-	550	110	190	24.0	190	2.5	5.4	3.9
July 23	76	8.4	6930	5,400	130.0	26.0	890	420	240	130	220	N.F.	5.1	3.1
Nov. [illegible]	47	8.5	690	54,000	35.0	34.0	680	55.0	210	14	320	19.0	8.9	10.9

*Gaging station near Anoka, Minnesota
**Gaging station at Carver, Minnesota

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Rum River at Anoka Station Ru-0

Date	Temp.	pH	Flow* (cfs)	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Jan. 28	32	7.9	350	7,900	1.6	20	190	0.4	51.0	4.6	160	N.F.	11	1.2
March 9	32	7.6	305	3,300	8.0	18	230	5.4	80	3.2	160	0.5	8.9	1.4
April 16	41	8.0	2030	700	11.0	70	180	18	72	5.8	90	0.5	11.0	1.6
June 16	74	8.5	796	780	8.5	-	240	17	110	9.6	220	1.0	6.0	2.6
July 14	71	8.3	780	230	18.0	60	210	23	97	6.6	130	N.F.	6.9	2.2
Nov. 12	39	8.4	470	2,400	7.0	19	190	6.0	62	3.4	160	0.5	12.5	2.5

St. Croix River at Prescott Station SC-0

Date	Temp.	pH	Flow** (cfs)	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Jan. 21	34	7.9	2260	780	1.4	15	140	2.4	49	2.0	110	N.F.	11.0	1.6
March 12	35	7.8	2720	130	2.2	18	150	2.0	60	0.4	110	N.F.	8.9	2.1
April 13	43	7.6	15500	20	10.0	70	120	6.2	11.0	N.F.	50	0.5	10.0	1.9
June 17	71	8.1	7590	230	4.5	-	140	8.2	110	7.0	55	0.5	6.2	1.4
July 13	74	7.8	5140	490	2.7	130	130	11.0	65	1.8	60	N.F.	4.2	3.0
Aug. 27	78	8.1	3760	130	12.5	100	200	25	63	3.0	62	N.F.	4.2	1.8
Nov. 13	49	8.5	2550	<20	6.0	22	130	11	42	3.0	110	N.F.	9.4	1.8

St. Croix River at Stillwater Station SC-22.6

Date	Temp.	pH	Flow** (cfs)	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Jan. 21	33	7.8	2260	1,100	1.5	16	130	1.8	54	2.4	110	N.F.	10	0.87
March 12	32	7.8	2720	3,300	5.7	20	120	4.2	38	1.4	100	N.F.	9.2	1.3
April 13	44	7.6	15500	330	7.0	90	110	9.6	20	0.4	50	0.5	11.0	2.3
June 17	75	8.1	7590	790	12.0	-	160	17.0	120	8.0	70	0.5	5.5	2.0
July 13	73	7.7	5140	140	20	120	130	20	64	6.2	68	N.F.	5.2	2.6
Aug. 27	77	8.3	3760	490	10.5	95	210	17.0	51	5.4	78	N.F.	6.2	1.6
Nov. 13	39	8.6	2550	490	6.0	19	120	5.6	94	2.6	100	N.F.	12.2	2.9

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* Gaging station at St. Francis, Minnesota
**Gaging station near St. Croix Falls, Wisconsin

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St. Croix River at Taylor Falls — Station SC-51.6

Date	Temp.	pH	Flow* (cfs)	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Jan. 21	33	7.8	2260	<200	2.5	18.0	110	2.8	45	4.4	95	N.F.	10.0	1.2
March 12	32	7.8	2720	330	3.4	20.0	130	4.4	26	1.8	90	N.F.	9.2	1.9
April 13	42	7.6	15500	260	8.0	92	110	5.8	4.0	N.F.	40	0.5	11.0	1.9
June 17	75	8.0	7590	220	7.5	-	130	12.0	65	6.4	60	0.5	5.4	1.4
July 13	72	7.8	5140	230	13	120	130	21.0	55	5.8	60	N.F.	6.0	1.1
Aug. 27	78	8.2	3760	330	9.5	90	180	11.0	59	3.4	74	N.F.	5.8	1.7
Nov. 13	39	8.5	2550	330	6.0	21.0	120	4.0	54	1.6	88	N.F.	12.1	2.3

St. Louis River at Brookston — Station SL-1

Date	Temp.	pH	Flow** (cfs)	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Jan. 12	33	7.5	970	1,700	35	100	340	210	89	35	72	1.0	7.3	3.2
March 2	32	7.5	1010	-	9.0	94	160	52	58	7.8	70	0.5	8.8	1.9
April 20	39	7.6	3550	230	9.5	140	110	13	61	2.1	38	0.5	11.0	[illegible]
July 20	79	7.4	2980	490	6.0	250	260	13.0	190	7.0	50	N.F.	3.3	[illegible]
Nov. 16	39	8.0	1390	490	7.0	130	120	4.6	67	2.4	54	N.F.	11.[illegible]	[illegible]

St. Louis River at Cloquet — Station SL-3

Date	Temp.	pH	Flow** (cfs)	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Jan. 12	33	7.5	970	24,000	12.0	100	130	26	81	22	60	1.0	-	[illegible]
March 2	33	7.4	1010	23,000	8.0	92	130	5.0	54	5.2	65	0.5	8.5	[illegible]
April 20	37	7.5	3550	35,000	21.0	140	120	13.0	66	4.3	40	0.5	10.0	4.0
July 20	77	7.4	2980	35,000	5.5	240	300	13.0	240	5.2	50	N.F.	3.2	2.0
Nov. 16	39	7.8	1390	24,000	8.0	130	140	5.4	73	3.6	58	N.F.	10.6	4.2

* Gaging station near St. Croix Falls, Wisconsin
**Gaging station at Scanlon, Minnesota

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Station SL-8

St. Louis River at Fond du Lac

Date	Temp.	pH	Flow* (cfs)	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Jan. 12	33	7.3	970	3,300	20.0	100	190	44	110	34	72	8.0	7.5	>6.9
March 2	32	7.3	1010	4,900	9.0	84	190	7.4	100	5.4	75	0.5	7.6	13.0
April 20	37	7.7	3550	3,300	18.0	150	130	15	72	4.1	33.0	1.0	10.0	4.3
July 20	77	7.6	2980	2,200	5.5	230	240	10	170	6.6	55.0	1.0	2.8	2.3
Nov. 16	39	7.4	1390	3,500	11.0	130	190	11.0	110	6.0	58.0	N.F.	8.4	11.0

Station Sa-0

Sauk River at Sauk Rapids

Date	Temp.	pH	Flow** (cfs)	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Jan. 28	32	8.1	90	2,300	2.1	20	330	1.8	120	5.0	250	N.F.	9.9	1.8
March 9	32	7.9	75	1,100	10.0	15	370	6.8	140	2.8	250	6.0	7.8	1.3
April 16	41	8.8	920	790	19.0	29	320	25.0	120	11.0	190	0.5	12.0	4.8
June 16	72	8.2	1430	54,000	60.0	-	340	150	130	32.0	230	0.5	5.2	5.8
July 14	73	8.5	767	3,300	15.0	35	300	25	140	11.0	190	4.0	7.1	3.7
Nov. 12	39	8.4	86	700	10.0	20	280	6.4	98	2.6	200	4.0	11.3	3.9

Station SR-13.3

Shell Rock River at Albert Lea

Date	Temp.	pH	Flow*** (cfs)	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Jan. 19	35	7.8	22	200	17	64	520	10	230	21	230	95	N.F.	4.9
March 10	35	7.5	60	240,000	84	50	740	13	250	11	410	130	N.F.	14.0
April 14	46	9.3	154	78-1600	62	47	420	133	160	74	130	32	19.3	13.0
June 18	79	8.5	114	45	15	-	360	19	200	8.6	190	22	4.6	2.5
July 17	80	8.6	180	2,300	23	45	530	19	290	13	200	22	6.7	6.8
Nov. 30	34	8.6	28	1,700	17	55	450	23	160	15	200	63	13.0	7.9

* Gaging station at Scanlon, Minnesota
** Gaging station near St. Cloud, Minnesota
***Gaging station at Northwood, Iowa

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Upper Mississippi River at Anoka — **Station UM-14**

Date	Temp.	pH	Flow (cfs)	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Jan. 28	32	8.0	5100	1,700	1.5	20	110	0.4	48	3.0	200	N.F.	8.2	1.5
March 9	32	7.7	4100	1,300	10	18	240	5.6	100	1.8	180	0.5	7.3	1.4
April 16	40	8.1	18700	3,500	15	66	210	23	89	6.0	110	0.5	10.0	1.7
June 16	72	8.5	18500	54,000	25	-	230	44	110	9.8	240	0.5	5.7	2.2
July 14	72	8.4	16400	7,900	23	100	230	31	99	8.8	130	N.F.	5.9	1.2
Nov. 12	40	8.5	5990	9,200	7.0	32	210	8.2	67	4.4	150	N.F.	12.1	2.6

Upper Mississippi River at Sauk Rapids — **Station [illegible]**

Date	Temp.	pH	Flow* (cfs)	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Jan. 28	32	8.0	3350	1,300	28	23	240	49.0	98	17.0	170	-	7.9	2.9
March 9	32	7.8	2660	92,000	9	18	230	4.6	110	1.6	170	1.0	8.1	1.5
April 16	40	8.1	10800	700	18	82	190	21.0	92	5.8	110	0.5	10	1.3
June 16	72	8.4	12700	11,000	49	-	220	55	89	13.0	170	1.0	5.8	4.3
July 14	72	8.3	10900	7,000	30	120	210	28	110	6.8	110	N.F.	5.8	1.2
Nov. 12	39	8.5	4350	700	9.0	25	190	7.0	77	3.4	150	N.F.	12.6	2.5

*Gaging station near Royalton

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Cannon River at Welch — Station Ca-13.4

Date	Temp.	pH	Flow (cfs)	Coliform Group	Turb.	Color	TS	TSS	TVm	TSVm	Alk.	Total Hard.	Cl	DO	BOD
Jan. 14	32	8.1	210	9,200	6.0	15	380	6.6	150	3.2	270	-	15.0	11	2.4
April 26	58	8.2	307	22,000	44	22	410	35	130	7.4	220	-	5.5	10	3.1
June 8	70	7.9	420	3,300	24	28	370	25	170	8.2	210	-	5.5	8.7	1.4
July 13	79	8.1	435	240,000	33	40	380	32	130	7.5	210	-	4.5	7.7	1.8
Aug. 25	-	8.0	247	16,000	25	25	-	-	-	-	220	260	-	8.8	1.7
Sept. 24	59	8.1	271	13,000	20	17	270	15	130	4.4	240	-	3.5	9.9	1.2
Nov. 18	43	8.3	357	4,600	8	20	380	7.6	82.0	5.0	250	-	8.0	14.0	4.2
Dec. 28	33	8.3	344	1,700	8	23	400	3.8	160	1.8	270	-	9.0	14.0	1.5

Crow River at Dayton — Station Cr-0

Date	Temp.	pH	Flow* (cfs)	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Jan. 26	32	8.0	76	1,700	9.0	18	440	4.4	100	1.8	320	7.0	8.1	2.0
April 14	55	8.5	706	260	18.0	25	430	54	150	12.0	220	4.0	14.0	7.8
June 10	74	8.3	471	1,300	43.0	35	460	34	170	24.0	240	3.5	10.0	6.2
Aug. 8	76	8.3	120	3,300	140	70	460	65	200	24.0	240	8.0	12.0	12.0
Sept. 23	60	8.0	341	790	40	54	450	47	170	12.0	270	7.0	9.7	2.8
Dec. 8	32	8.3	110	790	10	32	460	7.8	180	3.4	320	9.5	14.0	3.2

Des Moines River at Jackson — Station De-11.1

Date	Temp.	pH	Flow*** (cfs)	Coliform Group	Turb.	Color	TS	TSS	TVm	TSVm	Alk.	Cl	DO	BOD
April 21	54	8.0	336	240,000	85	36	550	62	110	18	160	7.0	9.5	4.4
June 23	72	8.1	550	130,000	270	30	700	190	170	40	130	5.0	7.4	6.1
July 14	81	8.0	116	170,000	150	32	700	100	210	31	150	9.5	6.3	8.0
Sept. 22	60	8.0	36	<160,000	49	26	540	46	180	15	240	9.5	9.5	7.3
Nov. 23	40	7.9	51	350,000	15	25	580	22	120	9	210	N.F.	13.0	5.1

*Gauging Station at Rockford, Minnesota. ***Gauging Station at Jackson, Minnesota.

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Des Moines River near Jackson — Station Dm-14

Date	Temp.	pH	Flow (cfs)	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
April 21	54	8.0	336	2,300	85	36	580	71	160	18	160	2.0	9.6	4.6
June 23	72	8.1	550	35.000	280	30	760	250	190	50	150	4.0	.2	5.6
July 14	79	8.1	116	130	140	30	700	120	200	34	151	7.5	6.5	9.2
Sept. 22	56	8.0	36	7,900	61	30	550	68	160	17	230	10	9.7	4.7
Nov. 23	40	8.0	51	200	19	23	610	34	130	9.8	210	N.F.	13	42

Lower Mississippi River at Fridley — Station LM-1

Date	Temp.	pH	Flow* (cfs)	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Jan. 26	35	7.8	15,400	4,900	10	22	220	3.2	72	1.8	170	N.F.	9.0	1.6
April 27	58	8.0	22,100	4,900	53	63	200	34.0	86	8.6	71	N.F.	9.6	3.2
June 10	70	8.0	17,300	4,600	14	60	190	31	75	9.0	110	0.5	7.4	3.0
Aug. 2	72	8.2	5,990	4,900	40	60	200	11.0	84.0	4.0	140	1.0	8.6	3.1
Sept. 23	58	7.9	6,720	9,200	21	36	210	14	110	4.8	150	0.5	10.0	2.0

Minnesota River near Shakopee — Station Mi-16.8

Date	Temp.	pH	Flow ** (cfs)	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Jan. 28	32	8.1	390	13,000	12.0	18.0	760	8.2	220	3.4	380	23.0	3.2	3.8(6-Day)
April 21	54	7.3	3,600	330	100.0	31.0	740	130	180	24.0	200	1.0	9.8	3.3
June 23	73	7.6	8,720	11,000	650	40.0	1000	580	220	80	180	2.5	5.3	3.1
July 15	80	8.2	2,540	4,900	120	29.0	690	160	220	31.0	240	9.0	7.5	4.1
Nov. 23	32	7.8	807	7,900	21	29.0	550	46.0	160	15	280	-	12.0	5.9
Dec. 29	33	8.2	374	4,900	13.0	24.0	640	11.0	170	6.0	340	19.0	13.0	4.6

*Gauging Station at Anoka, Minnesota. **Gauging Station near Carver, Minnesota.

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Rum River at Anoka — Station Ru-0

Date	Temp.	pH	Flow (cfs)*	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Jan. 26	32	7.9	340	9,200	7	18	200	4.8	46	2.4	150	N.F.	9.8	3.8
April 27	50	7.9	2,100	4,900	48	40	210	46	91	12	130	N.F.	9.8	3.6
June 7	72	8.0	2,080	2,300	14	40	190	47	91	17	98	N.F.	7.4	2.1
Aug. 2	70	8.2	564	4,900	38	50	300	20	95	6.0	85	N.F.	8.1	4.2
Sept. 23	56	7.6	1,040	3,500	25	65	190	26	100	6.6	130	N.F.	9.2	2.1
Dec. 8	32	8.3	355	2,400	8	35	270	6.8	110	2.8	190	1.5	12.0	2.5

St. Croix River at Prescott — Station SC-0

Date	Temp.	pH	Flow (cfs)**	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Jan. 14	32	8.0	2,390	330	6.0	30	130	3.6	76	2.6	100	N.F.	11	2.1
April 26	48	7.8	12,400	78	12	50	130	4.4	58	2.6	56	N.F.	10	2.4
June 8	62	7.4	8,420	78	12	64	110	8.8	62	6.6	68	N.F.	7.9	1.8
July 13	75	7.6	17,900	490	13	160	110	6.5	66	4.0	55	N.F.	4.8	0.25
Sept. 24	64	7.5	7,150	68	13	35	120	6.2	45	1.6	90	5.5	7.2	0.55
Nov. 18	42	7.8	3,730	330	8	44	120	3.4	47	1.6	80	N.F.	11.0	1.9
Dec. 28	33	8.0	2,580	45	9.0	37	130	2	43	1.0	100	N.F.	12.0	0.95

St. Croix River at Stillwater — Station SC-22.6

Date	Temp.	pH	Flow (cfs)***	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Jan. 14	32	7.7	2,390	1,100	7.0	22.0	130	4.4	78	2.6	100	N.F.	11.0	1.7
April 26	54	7.6	12,400	460	14.0	65	120	14.0	86	6.4	55	N.F.	9.7	2.2
June 8	65	7.3	8,420	330	14	84	120	18.0	60	6.2	55	N.F.	7.9	2.1
July 13	75	7.4	17,900	790	18	160	120	22.0	52	5.5	48	N.F.	5.6	0.65
Sept. 24	58	7.4	7,150	450	20	70	120	20	43	5.0	70	N.F.	8.8	0.75
Nov. 18	42	7.7	3,730	330	11	41	140	4.6	42	3.2	90	N.F.	13.0	2.5
Dec. 28	31	8.0	2,580	1,300	12	35	120	0.8	45	N.F.	95	N.F.	13.0	0.85

*Gauging Station near St. Francis, Minnesota.
**Gauging Station near St. Croix Falls, Wisconsin
***Gauging Station near St. Croix Falls, Wisconsin

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St. Croix River at Taylor Falls — Station SC-51.6

Date	Temp.	pH	Flow (cfs)*	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Jan. 14	32	7.7	2,390	330	9.0	30	120	2.2	64	2.2	86	N.F.	10	1.0
April 26	54	7.5	12,400	330	21	70	140	18.0	80	5.8	36	N.F.	9.9	2.4
June 8	65	7.2	8,420	490	11	88	130	18.0	79	6.6	54	N.F.	7.3	2.3
July 13	70	7.3	17,900	790	15	170	120	19.0	58	6.5	38	N.F.	5.0	0.65
Sept. 24	56	7.4	7,150	230	12	70	110	7.2	60	5.0	60	N.F.	9.2	1.6
Nov. 18	42	7.6	3,730	220	8	39	110	13	39	3.8	76	N.F.	13.0	2.3
Dec. 28	32	7.9	2,580	130	11	33	120	2.0	49	0.6	90	N.F.	13.0	1.1

St. Louis River near Brookston — Station SL-1

Date	Temp.	pH	Flow (cfs)**	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Jan. 19	32	7.6	1,420	170	11.0	140	150	6.2	56	0.2	60.0	N.F.	9.0	1.3
April 5	34	7.8	1,150	490	20.0	95	150	6.4	40	0.4	75.0	N.F.	9.9	2.9
June 15	68	7.0	5,550	790	30.0	230	130	21.0	79	9.2	70.0	1.0	6.2	0.25
July 13	75	7.4	1,860	93	6.5	140	78.0	5.8	49.0	2.4	35.0	N.F.	5.9	0.38
Sept. 28	57	7.6	878	230	75	74	99.0	5.4	5.4	59	65.0	N.F.	9.9	1.4
Nov. 15	37	8.1	1,060	460	13	80	120	4.2	70	0.4	58.0	N.F.	14.0	2.6

St. Louis River near Cloquet — Station SL-3

Date	Temp.	pH	Flow (cfs)***	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Jan. 19	32	7.4	1,420	54,000	8.0	140	150	4.0	44	0.4	60	N.F.	-	4.7
April 5	34	7.8	1,150	35,000	27.0	100	160	8.8	46	0.2	84	N.F.	9.9	7.8
June 15	69	6.9	5,550	35,000	39.0	270	160	21.0	110	6.6	42	N.F.	5.5	1.1
July 13	75	7.1	1,860	49,000	12.0	150	120	11.0	63	5.0	50	N.F.	4.8	2.3
Sept. 28	58	7.0	878	49,000	12.0	76	120	7.6	56	4.8	63	N.F.	7.7	4.2
Nov. 15	38	7.7	1,060	160,000	18.0	100	120	6.2	69	0.6	63	0.5	12.0	6.2

*Gauging Station near St. Croix Falls, Wisconsin
**Gauging Station at Scanlon, Minnesota
***Gauging Station at Scanlon, Minnesota

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St. Louis River at Fond du Lac — Station SL-8

Date	Temp.	pH	Flow (cfs)*	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Jan.19	32	7.2	1,420	5,400	13.0	130	200	8.0	100	3.6	69	N.F.	-	14.0
April 5	34	7.5	1,180	5,400	27.0	100	210	10.0	72.0	1.2	95	N.F.	8.9	13.0
June 15	67	6.0	5,550	13,000	45.0	220	170	23.0	109	7.2	38	1.0	5.8	1.1
July 13	72	6.9	1,860	4,900	11.0	150	160	16.0	90	5.8	50	N.F.	2.5	2.9
Sept. 28	58	6.7	878	7,900	55.0	100	190	7.2	110	4.2	48	6.0	2.4	12.0
Nov 15	39	7.3	1,060	4,900	30.0	100	200	8.6	120	0.4	70	6.0	8.4	21.0

Sauk River at Sauk Rapids — Station Sa-9

Date	Temp.	pH	Flow*** (cfs)	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Jan. 26	32	8.1	128	3,500	8	19	370	4.8	96	2.6	260	N.F.	8.2	1.4
April 14	54	8.2	164	490	20	22	300	32	120	2.0	180	1.5	12.0	2.6
June 9	70	7.9	825	2,300	16	35	280	38	110	10.0	180	N.F.	8.0	2.2
Aug. 2	74	8.0	209	780	28	37	250	8.0	110	1.6	180	3.0	8.4	2.4
Sept. 23	56	8.0	317	9,200	10	22	250	11.0	130	4.0	180	2.0	10.0	1.8
Dec. 8	32	8.2	130	3,300	8.0	23	300	5.8	130	2.4	230	3.0	13.0	3.2

Shell Rock River near Albert Lea — Station SR-13.3

Date	Temp.	pH	Flow (cfs)**	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Jan. 29	37	8.0	12	680	15	50	620	14	200	9.6	320	90	N.F.	7.0 (6-Day.
April 22	54	9.1	89	200	75	45	500	78	280	31	210	75	16.0	24.0
June 10	71	8.6	120	2,000	22	37	410	32	170	26	190	51	11.0	5.3
July 12	80	9.7	105	<200	130	70	340	42	140	39	140	31	13.0	4.3
Sept. 22	58	9.2	48	20,000	80	58	450	23	210	16	130	96	9.8	16.0
Nov. 22	41	8.4	60	200	23	40	300	28	36	11.0	150		11.0	10.0
Dec. 29	34	7.8	40	2,300	16	48	450	12	150	12.0	220	64	0.25	4.3

*Gauging Station at Scanlon, Minnesota/
**Gauging Station at Northwood, Iowa.
** Gauging Station near St. Cloud, Minnesota.

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Upper Mississippi River at Anoka

Station UM-14

Date	Temp.	pH	Flow (cfs)	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Jan. 26	32	8.0	5,400	1,300	8	21	210	2.0	54	1.2	170	N.F.	9.1	1.2
April 27	50	7.7	22,100	4,900	48	66	200	40	82	8.4	95	N.F.	10.0	3.1
June 9	68	8.3	17,300	4,900	20	58	230	29	120	9.0	130	N.F.	7.5	1.3
Aug. 2	76	8.2	15,990	4,900	110	60	300	45	150	8.4	140	N.F.	8.7	3.3
Sept. 23	58	8.0	6,720	9,200	10	25	200	9.8	100	4.2	160	0.5	10.0	1.8
Dec. 8	32	8.4	3,300	2,300	6.0	38	220	6.4	93	3.6	180	0.5	14.0	2.3

Upper Mississippi River at Sauk Rapids

Station UM-68

Date	Temp.	pH	Flow (cfs)*	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Jan. 26	32	8.1	3,860	4,900	8	25	210	6.6	58	3.2	170	N.F.	9.2	2.2
April 14	54	8.0	16,700	790	22	47	250	120	84	11.0	110	N.F.	12.0	2.2
June 9	68	7.8	10,300	1,100	20	60	180	23	78	6.8	120	N.F.	8.0	1.9
Aug. 2	74	8.0	3,820	1,300	28	39	250	8.4	120	2.8	160	1.0	8.2	2.2
Sept. 23	58	7.9	3,280	2,400	11	25	190	13.0	93	6.4	160	N.F.	9.7	2.1
Dec. 8	32	8.2	3,090	1,100	14	28	220	11.0	100	4.4	170	N.F.	13	2.3

*Gauging Station near Royalton, Minnesota.

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Blue Earth River near Winnebago — Station BE-63

Date	Temp	pH	Flow cfs*	Coliform Group	Turb.	DO	BOD
Feb. 16	32	7.4	113	22,000	15.0	3.5	2.2
April 14	59	8.4	515	4,900	19.0	11.0	5.0
June 16	73	8.1	458	54,000	70.0	7.2	5.8
Aug. 9	79	7.8	65	920,000	14.0	7.6	10.0
Dec. 1	32	7.7	17	490,000	15.0	15.0	2.9

Blue Earth River near Blue Earth — Station BE-84

Date	Temp	pH	Flow cfs**	Coliform Group	Turb	DO	BOD
Feb. 16	32	7.4	113	7,900	14.0	2.0	2.4
April 14	59	8.2	515	4,900	18.0	9.8	2.5
June 16	71	8.1	458	92,000	80.0	6.6	4.9
Aug. 9	78	8.1	65	3,300	19.0	10.0	7.2
Dec. 1	32	7.6	17	2,000	12.0	9.0	2.7

Cannon River near Faribault — Station Ca-49

Date	Temp	pH	Flow cfs***	Coliform Group	Turb	DO	BOD
Feb. 8	32	7.6	209	160,000	8.0	5.1	5.3
April 5	42	8.1	1,200	2,000	50	11.0	5.3
May 3	69	8.3	449	170,000	19	7.8	6.0
June 14	67	8.2	226	2,000	23	19.3	11.0
Aug. 2	81	7.8	210	1,300	32	8.1	9.4
Nov. 22	36	7.7	197	540,000	12	7.8	9.4

*Gauging Station at Rapidan, Minnesota
**Gauging Station at Rapidan, Minnesota
***Gauging Station at Welch, Minnesota

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Cannon River at Welch — Station Ca-13.4

Date	Temp	pH	Flow cfs	Coliform Group	Turb.	DO	BOD
Feb. 9	34	8.1	207	2,000	7.5	10.0	2.1
April 18	60	8.5	530	2,300	20	11.0	3.8
June 15	70	8.2	224	4,900	18	8.8	1.6
Aug. 3	78	8.1	228	11,000	36	7.8	3.6
Oct. 13	59	7.0	122	7,000	15	10.0	4.9

Cannon River near Northfield — Station Ca-37.6

Date	Temp	pH	Flow cfs*	Coliform Group	Turb.	DO	BOD
Feb. 8	32	7.8	209	54,000	7.5	6.1	2.9
April 5	43	8.0	1,200	33,000	47	11.0	6.6
May 3	70	8.3	449	130,000	18	8.9	6.4
June 14	70	8.0	226	13,000	12	8.7	3.9
Aug. 2	83	8.0	210	23,000	29	6.2	9.8
Nov. 22	33	7.7	197	110,000	10	10.0	5.1

Crow River at Dayton — Station Cr-0

Date	Temp	pH	Flow cfs**	Coliform Group	Turb	Color	TS	TSS	TVM	TSVM	Alk	Cl	DO	BOD
Jan. 10	32	8.2	80	270	9.0	23.0	470	4.6	190	2.8	350	10.0	13.0	1.3
Feb. 23	36	7.3	73	700	10.0	-	-	-	-	-	-	-	10.0	1.3
April 20	59	8.4	820	330	60.0	-	-	-	-	-	-	-	10.0	5.0
June 14	64	8.3	174	400	24.0	-	-	-	-	-	-	-	9.8	7.9
Nov. 21	33	8.1	45	170	9.0	-	-	-	-	-	-	-	14.0	2.4

*Gauging Station at Welch, Minnesota
**Gauging Station at Rockford, Minnesota

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Minnesota River near Shakopee — Station Mi-16.8

Date	Temp	pH	Flow cfs*	Coliform Group	Turb	DO	BOD
Feb. 16	32	7.5	320	3,300	15.0	2.7	1.8
April 6	45	7.9	4,190	11,000	160.0	9.4	4.0
June 7	70	8.2	1,860	13,000	140,0	4.5	6.3
July 6	80	8.3	1,430	4,900	50.0	6.2	5.1
Sept. 8	68	7.8	707	24,000	50.0	5.6	6.4

Minnesota River near Jordan — Station Mi-39

Date	Temp	pH	Flow cfs**	Coliform Group	Turb	DO	BOD
Feb. 24	33	7.7	350	3,300	7.5	5.6	1.1
April 6	45	8.0	4,190	4,900	160	9.8	4.4
June 7	71	8.1	1,860	7,900	160	5.9	6.4
July 6	80	8.5	1,430	7,900	48	5.8	7.1
Sept. 8	68	7.9	707	17,000	32	7.7	6.6

Minnesota River at St. Peter — Station Mi-97

Date	Temp	pH	Flow cfs***	Coliform Group	Turb	DO	BOD
Feb. 24	32	7.8	290	22,000	6.5	7.5	2.0
April 6	44	7.9	2830	4,500	140	10.0	2.9
June 7	68	8.2	2420	54,000	240	6.9	3.9
July 6	80	8.2	2110	92,000	210	5.8	4.4
Sept. 8	69	8.1	840	79,000	38	10.0	7.9

*Gauging Station at Carver, Minnesota
**Gauging Station at Carver, Minnesota
***Gaging Station at Mankato, Minnesota

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Minnesota River at Henderson Station Mi-70

Date	Temp	pH	Flow cfs*	Coliform Group	Turb	DO	BOD
Feb. 24	32	7.7	350	24,000	7.0	6.1	1.4
April 6	44	8.0	4190	11,000	160	10.0	3.1
June 7	67	8.2	1860	35,000	220	6.3	5.3
July 6	82	8.1	1430	35,000	320	4.5	11.0
Sept. 8	69	8.0	707	35,000	35.0	8.6	6.5

Otter Tail River at Breckenridge Station OT-1

Date	Temp	pH	Flow cfs**	Coliform Group	Turb	Color	TS	TSS	TVM	TSVM	Alk	Cl	DO	BOD
Jan. 13	32	8.3	250	45	12	22	320	10.0	130	4.4	260	3.5	13.0	1.4
Jan. 31	32	8.3	190	330	12	-	-	-	-	-	-	-	12.0	3.0
April 26	60	8.3	440	450	100	-	-	-	-	-	-	-	8.9	2.6
July 7	78	8.3	650	2,400	450	-	-	-	-	-	-	-	6.0	2.4
Aug. 15	78	8.0	446	490	41	-	-	-	-	-	-	-	7.5	2.9

Red River at Grand Forks Station Re-6

Date	Temp	pH	Flow cfs	Coliform Group	Turb	Color	TS	TSS	TVM	TSVM	Alk	Cl	DO	BOD
Jan. 12	34	7.9	740	35900	15	24	410	13.0	150	5.6	270	10.0	11.0	4.9
Feb. 1	33	8.0	700	13,000	18	-	-	-	-	-	-	-	10.0	1.6
April 27	55	8.2	3,020	7,800	60	-	-	-	-	-	-	-	9.0	1.9
July 6	80	7.9	1,290	23,000	75	-	-	-	-	-	-	-	6.6	2.6
Aug. 16	74	8.0	1,940	13,000	110	-	-	-	-	-	-	-	6.9	1.1

*Gauging Station at Carver, Minnesota

**Gauging Station near Fergus Falls, Minnesota

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Rock River near Luverne — Station Ro-17

Date	Temp	pH	Flow cfs	Coliform Group	Turb	DO	BOD
Jan. 4	33	8.2	15.3	20	11	14.0	1.3
Feb. 16	32	7.6	4.5	2,400	220	4.3	5.9
April 14	50	8.4	46.5	200	14.0	11.0	5.3
June 16	69	8.0	18.0	2,300	45	6.1	5.9
Aug. 9	71	7.9	4.2	4,500	50	6.4	10.0
Dec. 1	32	7.8		1,700	13	13.0	2.8

Rum River at Anoka — Station Ru-0

Date	Temp	pH	Flow cfs*	Coliform Group	Turb	Color	TS	TSS	TVM	TSVM	Alk	Cl	DO	BOD
Jan. 10	34	8.3	340	490	9.0	24	260	3.2	110	2.2	190	NF	12.0	0.68
Feb. 23	33	6.8	288	3,500	12.0	-	-	-	-	-	-	-	9.8	1.8
April 20	56	8.3	982	780	20	-	-	-	-	-	-	-	10.0	3.6
June 14	64	8.3	360	1,300	19	-	-	-	-	-	-	-	8.6	4.9
Aug. 11	74	7.8	612	2,400	15	-	-	-	-	-	-	-	7.5	4.2
Nov. 21	33	8.0	370	7,000	8	-	-	-	-	-	-	-	13.0	2.8

Rum River at Isanti — Station Ru-34

Date	Temp	pH	Flow cfs**	Coliform Group	Turb	DO	BOD
Feb. 23	32	7.4	288	13,000	9.8	4.4	1.3
May 4	65	8.3	580	4,900	18	9.6	4.5
June 14	70	8.5	360	4,900	18	11.0	6.6
Aug. 11	76	8.2	612	13,000	18	9.2	5.1
Nov. 21	33	7.8	370	35,000	10	11.0	2.5

*Gauging Station near St. Francis, Minnesota
**Guaging Station near St. Francis, Minnesota

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Rum River at Westpoint — Station Ru-61

Date	Temp	pH	Flow cfs*	Coliform Group	Turb	DO	BOD
Feb. 23	32	7.3	288	7,900	9.5	4.3	1.2
May 4	65	8.3	580	450	17.0	9.0	3.4
June 14	70	8.2	360	2,300	20.0	9.2	4.8
Aug. 11	74	8.1	612	3,300	14.0	7.8	2.4
Nov. 21	33	7.9	370	4,900	8.0	12.0	2.0

Rum River near Pease — Station Ru-102

Date	Temp	pH	Flow cfs**	Coliform Group	Turb	DO	BOD
Feb. 23	32	7.4	288	4,900	8.0	6.8	2.5
May 4	64	8.3	580	330	12	9.2	2.2
June 14	74	8.5	360	4,900	12.0	9.7	2.4
Aug. 11	75	8.3	612	5,400	9.0	8.7	3.2
Nov. 21	33	8.0	370	5,400	10.0	12.0	2.2

St. Croix River at Prescott — Station SC-0

Date	Temp	pH	Flow cfs***	Coliform Group	Turb	DO	BOD
Feb. 9	32	7.9	2,400	790	8.0	11.0	1.2
April 18	50	8.0	11,000	78	12.0	9.5	2.2
May 19	64	8.0	2,670	45	12	9.4	2.0
June 15	73	8.6	5.110	20	12	9.6	4.3
Aug. 3	82	8.0	14,100	93	17	7.1	2.6
Oct. 13	60	6.9	3,970	45	14	7.3	1.6

*Gauging Station at St. Francis, Minnesota
**Gauging Station near St. Francis, Minnesota
***Gauging Station near St. Croix Falls, Wisconsin

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St. Croix River at Stillwater Station SC-22.6

Date	Temp	pH	Flow cfs*	Coliform Group	Turb	DO	BOD
Feb. 9	32	8.1	2,400	790	8.1	9.2	0.95
April 18	53	8.0	11,000	330	18	9.6	2.3
May 19	71	8.2	2,670	130	15	8.9	2.4
June 14	71	8.0	5,110	790	20	8.2	4.7
Aug. 3	82	7.3	14,100	5400	27	5.8	1.4
Oct. 13	58	6.7	3,970	1,300	17	8.6	2.7

St. Croix River at Taylors Falls Station SC-51.8

Date	Temp	pH	Flow cfs**	Coliform Group	Turb	DO	BOD
Feb. 9	32	8.0	2,400	330	7.2	9.1	0.70
April 18	53	8.0	11,000	170	13.0	9.7	2.0
May 19	72	8.3	2,670	490	14.0	10.0	2.4
June 15	70	8.0	5,110	230	14.0	7.5	1.9
Aug. 3	81	7.0	14,100	170	20.0	4.0	2.0
Oct. 13	58	6.6	3,870	78	15.0	8.0	3.2

St. Louis River near Brookston Station SL-1

Date	Temp	pH	Flow cfs***	Coliform Group	Turb	Color	TS	TSS	TVM	TSVM	Alk	Cl	DO	BOD
Jan. 11	32	7.4	878	790	64.0	74	220	100	71	15	68	1.0	10.0	1.2
Feb. 3	32	7.6	840	230	40.0	-	-	-	-	-	-	-	9.6	2.7
April 28	55	8.0	2,680	450	18.0	-	-	-	-	-	-	-	7.7	1.5
July 5	72	7.3	5,170	1,100	28.0	-	-	-	-	-	-	-	4.5	3.4
Aug. 17	-	7.1	1,500	4,900	12.0	-	-	-	-	-	-	-	5.0	2.5

*Gauging Station near St. Croix Falls, Wisconsin
**Gauging Station near St. Croix Falls, Wisconsin
***Gauging Station at Scanlon, Minnesota

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Sauk River at Sauk Rapids — **Station Sa-0**

Date	Temp	pH	Flow cfs*	Coliform Group	Turb	Color	TS	TSS	TVM	TSVM	Alk	Cl	DO	BOD
Jan. 10	34	8.2	110	3,300	8.5	24	350	3.6	150	2.8	250	3.5	12.0	1.6
Feb. 23	32	7.5	124	1,700	12.0	-	-	-	-	-	-	-	8.3	1.1
April 20	56	8.4	458	450	18.0	-	-	-	-	-	-	-	10.0	3.3
June 14	69	8.4	85	7,900	13.0	-	-	-	-	-	-	-	9.6	2.1
Aug. 11	72	8.4	91	13,000	21.0	-	-	-	-	-	-	-	9.0	7.4
Nov. 21	33	8.1	49	2,300	10.0	-	-	-	-	-	-	-	13.0	2.2

Shellrock River near Albert Lea — **Station SR-13.3**

Date	Temp	pH	Flow cfs**	Coliform Group	Turb	DO	BOD
Feb. 15	35	7.4	20	2,000	92	NF	18
April 13	56	7.5	142	450	28	14.0	14.0
June 15	68	9.1	138	2,000	90	8.8	23.0
Aug. 8	78	9.7	21	200	92	19.0	34.0

Straight River near Clinton Falls — **Station St-18**

Date	Temp	pH	Flow cfs	Coliform Group	Turb	DO	BOD
Feb. 8	32	7.8	-	92,000	9.0	10.0	4.3
April 5	45	8.1	-	4,000	32.0	11.0	3.0
May 3	68	8.3	-	13,000	20.0	9.8	3.4
June 14	71	8.1	-	130,000	23.0	7.9	5.4
Aug. 2	82	8.1	-	540,000	15.0	8.6	9.9
Nov. 22	38	7.8	-	350,000	12.0	9.2	6.6

*Gauging Station near St. Cloud, Minnesota
**Gauging Station at Northwood, Iowa

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Upper Mississippi River at Anoka — Station UM-14

Date	Temp	pH	Flow cfs	Coliform Group	Turb	Color	TS	TSS	TVM	TSVM	Alk	Cl	DO	BOD
Jan. 10	33	8.3	4,240	450	8.0	24	250	3.8	93	2.2	190	NF	12	1.2
Feb. 23	32	7.1	3,300	1,700	9.5	-	-	-	-	-	-	-	6.8	1.4
April 20	53	8.3	11,400	2,300	16.0	-	-	-	-	-	-	-	9.8	2.6
June 14	64	8.0	8,030	4,900	24.0	-	-	-	-	-	-	-	7.5	1.3
Nov. 21	33	8.2	3,460	4900	10	-	-	-	-	-	-	-	14.0	2.4

Upper Mississippi River at Sauk Rapids — Station UM-68

Date	Temp	pH	Flow cfs*	Coliform Group	Turb	Color	TS	TSS	TVM	TSVM	Alk	Cl	DO	BOD
Jan. 10	33	8.2	2820	1,300	8.5	24	230	4.0	100	4.0	170	NF	12.0	1.5
Feb. 23	32	7.6	2190	7,900	10.5	-	-	-	-	-	-	-	7.0	1.0
April 20	53	8.2	6910	450	19.0	-	-	-	-	-	-	-	9.9	1.9
June 14	65	8.0	6660	780	26	-	-	-	-	-	-	-	7.5	1.8
Nov. 21	33	8.3	2760	2,300	10	-	-	-	-	-	-	-	14.0	2.5

Zumbro River, North Branch, near Zumbrota — Station NBZ-72

Date	Temp	pH	Flow cfs	Coliform Group	Turb	DO	BOD
Jan. 18	32	-	-	4,900	-	13.0	2.0
April 5	43	7.9	-	7,900	180	11.0	6.3
May 3	68	8.2	-	54,000	15	9.4	4.6
June 14	68	7.8	-	920,000	27	5.3	6.4
Aug. 2	79	7.8	-	7,000	20	2.7	4.5
Nov. 22	36	7.8	-	79,000	10	9.9	3.2

*Gauging Station near Royalton, Minnesota

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Blue Earth River near Winnebago — Station BE-63

Date	Temp.	pH	Flow* cfs	Coliform Group	Turb.	TS	TSS	TVM	TSVM	Color	Alk.	Cl	DO	BOD
May 8	60	8.6	483	3,300	15.0	-	-	-	-	-	-	-	12.0	4.7
July 24	80	8.3	259	230,000	33.0	500	69	180	17.0	35	230	1.0	9.2	4.6
Sept. 13	75	8.6	84	79,000	50.0	-	-	-	-	-	-	-	12.0	14.0
Nov. 14	43	8.4	**	11,000	8.0	-	-	-	-	-	-	-	16.0	3.2

Blue Earth River near Blue Earth — Station BE-84

Date	Temp.	pH	Flow* cfs	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
May 8	60	8.5	483	7,900	15.0	-	-	-	-	-	-	-	11.0	4.2
July 24	78	8.0	259	33,000	32.0	40	480	82	170	17	240	N.F.	5.1	4.7
Sept. 13	72	8.5	84	13,000	22.0	-	-	-	-	-	-	-	12.0	5.2
Nov. 14	42	8.4	**	780	8.0	-	-	-	-	-	-	-	15.0	3.9

Cannon River at Welch — Station Ca-13.4

Date	Temp.	pH	Flow cfs	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD	Radiological Analysis Diss. Solids Beta µµc/1
Feb. 14	33	8.0	215	4,900	6	-	-	-	-	-	-	-	12	1.5	-
April 24	48	8.2	204	2,300	12	-	-	-	-	-	-	-	12	3.9	-
July 24	73	8.2	342	49,000	15	35	300	20	130	4.8	200	N.F.	8.4	1.7	-
Sept. 11	64	8.3	180	3,300	10	-	-	-	-	-	-	-	9.7	1.6	-
Oct. 23	53	8.3	150****	3,300	6	-	-	-	-	-	-	-	11.0	1.4	6
Dec. 27	37	8.1	264****	2,400	7	-	-	-	-	-	-	-	12.0	1.7	-

* Gaging Station at Rapidan, Minnesota
** Flow readings are not yet available
**** Provisional Readings

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Cannon River near Northfield — Station Ca-37.6

Date	Temp.	pH	Flow* cfs	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Feb. 15	32	7.8	175	130,000	11	-	-	-	-	-	-	-	5.9	9.1
May 1	46	8.5	204	49,000	9	-	-	-	-	-	-	-	13.0	6.3
Aug. 28	80	9.1	193	240,000	27	45	440	80	190	36	230	14	20.0	12
Oct. 2	54	8.3	141****	79,000	9.0	23	380	12	120	5.6	260	26	10.0	3.8
Nov. 20	34	8.0	199****	49,000	8.0	-	-	-	-	-	-	-	11.0	4.3

Cannon River near Faribault — Station Ca-49

Date	Temp.	pH	Flow cfs*	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Feb. 15	32	7.7	175	79,000	14	-	-	-	-	-	-	-	1.5	21
May 1	46	8.3	204	4,000	8.5	-	-	-	-	-	-	-	12.0	6.5
Oct. 2	55	8.0	141****	240,000	10.0	30	440	15	140	8.4	250	32	6.9	7.3
Nov. 20	35	8.1	191****	350,000	12.0	-	-	-	-	-	-	-	11.0	5.6

Crow River at Dayton — Station Cr-0

Date	Temp.	pH	Flow*** cfs	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
April 26	45	9.0	645	3,500	28	-	-	-	-	-	-	-	12.0	6.5
June 27	72	7.7	2,700	92,000	32	80	430	80	160	22	170	N.F.	7.2	4.2
Aug. 30	74	8.2	1,290	24,000	15	55	350	38	160	13	210	3.0	7.1	3.8
Oct. 3	56	8.4	242****	2,000	15	-	-	-	-	-	-	-	9.9	4.7
Dec. 14	33	8.1	91****	1,300	7.0	-	-	-	-	-	-	-	14.0	1.2

* Gaging station at Welch, Minnesota
*** Gaging station at Rockford, Minnesota
****Provisional readings

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Crow River at Rockford — Station Cr-40

Date	Temp.	pH	Flow cfs	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Jan. 19	32	7.6	49	780	9	-	-	-	-	-	-	-	1.9	2.0
Sept. 18	63	8.4	514	3,300	26	65	370	72	140	15	230	6.0	10.0	6.1
Dec. 20	33	7.6	83****	1,700	6	-	-	-	-	-	-	-	14.0	2.7

Crow River at Watertown — Station Cr-59

Date	Temp.	pH	Flow* cfs	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Jan. 19	32	7.6	49	2,300	18	-	-	-	-	-	-	-	NF	18.0
Sept. 18	65	8.5	514	1,700	18	75	480	36	190	14	240	15.0	13.0	11.0
Dec. 20	33	7.9	83****	450	7	-	-	-	-	-	-	-	15.0	4.1

Crow River near Biscay — Station Cr-66

Date	Temp.	pH	Flow*** cfs	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Jan. 19	32	7.9	0.4	160,000	12	-	-	-	-	-	-	-	0.8	7.3
Sept. 18	63	8.3	29	160,000	18	65	450	29	170	10	220	11.0	9.7	6.7
Dec. 20	33	7.9	**	13,000	8	-	-	-	-	-	-	-	11.0	8.2

Des Moines River near Jackson — Station DM-8.3

Date	Temp.	pH	Flow cfs	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
May 5	60	8.8	35	7,900	16	-	-	-	-	-	-	-	14.0	11.0
July 24	78	8.4	16	13,000	36	40	480	95	160	30	150	NF	12.0	11.0
Sept. 13	69	8.3	0.2	3,300	57	-	-	-	-	-	-	-	9.7	7.6
Nov. 14	42	8.2	11****	110,000	16	-	-	-	-	-	-	-	12.0	11.0

* Gaging station at Rockford, Minnesota
** Flow readings are not yet available
*** Gaging station at Cosmos, Minnesota
**** Provisional readings

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Des Moines River near Jackson
Station DM-18

Date	Temp.	pH	Flow cfs	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
May 8	60	8.6	24	330	17	-	-	-	-	-	-	-	13.0	9.5
July 24	76	7.8	16	35,000	84	40	640	150	160	40	160	0.5	3.7	8.8
Sept. 13	69	8.3	0.2	1,100	68	-	-	-	-	-	-	-	6.8	6.3
Nov. 14	41	8.6	11****	780	17	-	-	-	-	-	-	-	19.0	11.0

Lower Mississippi River at Fridley
Station LM-1

Date	Temp.	pH	Flow* cfs	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
April 26	46	8.3	17,100	3,300	20	-	-	-	-	-	-	-	11.0	3.5
June 27	73	8.2	6,720	35,000	19	66	390	42	210	17	150	N.F.	8.1	4.7
Aug. 30	70	8.6	5,160****	4,900	12	45	250	21	120	9.4	230	4.0	9.2	5.1
Oct. 3	60	8.6	5,160	1,300	9.0	-	-	-	-	-	-	-	11.0	3.7
Dec. 14	33	8.3	2,450****	4,900	8.0	-	-	-	-	-	-	-	14.0	2.0

Minnesota River near Shakopee
Station Mi-16.8

Date	Temp.	pH	Flow** cfs	Coliform Group	Turb.	DO	BOD	Radiological Analysis Dissolved Solids Beta µµc/l
Jan. 19	32	7.7	240	7,900	7.0	0.4	4.0	-
Feb. 23	32	7.8	252	7,900	11.0	0.8	3.4	-
July 18	74	8.2	2,410	14,000	150.0	6.0	5.1	-
Sept. 18	62	8.2	742	24,000	22.0	8.0	6.6	-
Oct. 24	53	8.4	338****	540,000	18.0	3.5	6.5	2.0
Dec. 20	33	7.8	464****	11,000	12.0	14.0	7.2	-

* Gaging station at Anoka, Minnesota
** Gaging station at Carver, Minnesota
**** Provisional readings

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Minnesota River near Jordan — **Station Mi-39**

Date	Temp.	pH	Flow* cfs	Coliform Group	Turb.	DO	BOD	Radiological Analysis Dissolved Solids Beta μμc/l
Jan. 19	32	7.6	240	-	8.0	0.4	2.5	-
Feb. 23	33	7.8	252	3,300	9.0	2.5	2.0	-
July 18	76	8.3	2,410	35,000	120.0	7.4	5.0	-
Sept. 18	62	8.3	742	7,000	19.0	9.4	8.6	-
Oct. 24	51	8.4	338****	7,800	25.0	10.0	8.2	8.0
Dec. 20	33	7.7	464****	4,900	8.0	13.0	5.0	-

Minnesota River at Henderson — **Station Mi-70**

Date	Temp.	pH	Flow* cfs	Coliform Group	Turb.	DO	BOD	Radiological Analysis Dissolved Solids Beta μμc/l
Jan. 19	32	7.6	240	54,000	8.0	1.2	3.3	-
Feb. 23	32	7.9	252	49,000	9.0	2.4	2.5	-
July 18	78	8.3	2,410	79,000	160.0	7.8	6.5	-
Sept. 18	62	8.3	742	33,000	22.0	8.7	9.2	-
Oct. 24	51	8.5	**	13,000	18.0	12.0	8.9	11.0
Dec. 20	33	7.8	**	49,000	9.0	13.0	6.7	-

* Gaging station at Carver, Minnesota
** Flow records not yet available
**** Provisional readings

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Rock River near Luverne — Station Ro-17

Date	Temp.	pH	Flow** cfs	Coliform Group	Turb.	DO	BOD
May 8	56	8.4	-	200	14.0	9.3	5.4
July 24	72	8.2	-	4,900	33	6.9	6.1
Sept. 13	65	8.3	-	1,300	57.0	6.8	6.3
Nov. 14	36	8.2	-	400	12.0	12.0	3.5

Rum River at Anoka — Station Ru-0

Date	Temp.	pH	Flow*** cfs	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
April 26	43	8.0	907	3,500	13	-	-	-	-	-	-	-	11.0	4.2
June 27	69	7.8	477	3,400	17	60	240	26	140	16	140	NF	8.7	4.8
Aug. 30	74	8.4	340	1,700	11	45	230	24	110	11	160	1.0	7.7	4.2
Oct. 3	58	8.2	216****	490	7.0	-	-	-	-	-	-	-	9.9	3.1
Dec. 14	33	8.1	170****	610	6.0	-	-	-	-	-	-	-	13.0	1.0

Rum River at Isanti — Station Ru-34

Date	Temp.	pH	Flow*** cfs	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
April 26	46	8.0	907	3,300	13	-	-	-	-	-	-	-	11.0	3.1
June 27	71	8.2	477	92,000	22	70	230	31	130	12	140	NF	9.6	3.9
Aug. 28	71	8.7	340	11,000	11	37	220	19	130	9.4	80	1.0	11.0	5.6
Oct. 3	59	8.4	216****	35,000	7.0	-	-	-	-	-	-	-	11.0	3.4
Dec. 14	33	7.9	170****	<200	7.0	-	-	-	-	-	-	-	8.8	1.1

** Flow readings not yet available
*** Gaging station near St. Francis, Minnesota
****Provisional readings

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Rum River at West Point — Station Ru-61

Date	Temp.	pH	Flow* cfs	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
April 26	46	8.0	907	16,000	12	-	-	-	-	-	-	-	9.8	2.6
June 27	70	7.9	477	35,000	19	40	210	48	100	14	110	NF	7.7	4.0
Aug. 30	71	7.8	340	3,300	7.5	37	200	16	120	6.4	130	NF	8.3	3.3
Oct. 3	60	8.3	216****	3,300	7.0	-	-	-	-	-	-	-	9.7	3.1
Dec. 14	33	7.9	170****	4,900	7.0	-	-	-	-	-	-	-	8.5	1.0

Rum River near Pease — Station Ru-102

Date	Temp.	pH	Flow* cfs	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
April 26	46	8.2	907	3,500	10	-	-	-	-	-	-	-	12	3.1
June 27	70	8.3	477	13,000	15	35	160	17	85	11	88	NF	9.9	3.2
Aug. 30	70	8.1	340	4,900	7.0	40	140	76	130	54	98	1.0	9.4	3.0
Oct. 3	60	8.3	216****	4,900	6.0	-	-	-	-	-	-	-	9.8	2.4
Dec. 14	33	8.0	170****	7,900	3.0	-	-	-	-	-	-	-	8.2	2.0

St. Croix River at Prescott — Station SC-0

Date	Temp.	pH	Flow*** cfs	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Feb. 14	32	7.6	2,570	310	7	-	-	-	-	-	-	-	9.6	2.0
April 24	46	7.7	8,370	490	12	-	-	-	-	-	-	-	10.0	2.6
July 25	77	8.5	3,350	78	6	50	120	6.8	60	3.6	82	NF	9.4	3.3
Sept. 11	66	8.5	2,440	<200	8.0	-	-	-	-	-	-	-	10	5.8
Oct. 23	58	7.9	**	230	10.0	-	-	-	-	-	-	-	7.4	2.2
Dec. 27	33	8.2	**	330	7.0	-	-	-	-	-	-	-	12.0	0.8

* Gaging station near St. Francis, Minnesota
** Flow readings not yet available
*** Gaging station near St. Croix Falls, Wisconsin
**** Provisional readings

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St. Croix River at Stillwater

Station SC-22.6

Date	Temp.	pH	Flow*** cfs	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD	Radiological Analysis Diss. Solids Beta μμc/l
Feb. 14	32	7.6	2,570	2,400	8	-	-	-	-	-	-	-	10	2.4	-
April 24	46	7.8	8,370	490	12	-	-	-	-	-	-	-	11	3.0	-
July 25	75	8.3	3,350	2,300	11	60	150	15	82	3.2	80	NF	8.6	3.0	-
Sept. 11	65	8.3	2,440	2,300	10	-	-	-	-	-	-	-	9.4	3.4	-
Oct. 23	55	8.3	**	4,900	9.0	-	-	-	-	-	-	-	9.5	1.6	1
Dec. 27	33	7.8	**	2,400	7.0	-	-	-	-	-	-	-	11.0	0.9	-

St. Croix River at Taylors Falls

Station SC-51.6

Date	Temp.	pH	Flow* cfs	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD	Radiological Analysis Diss. Solids Beta μμc/1
Feb. 14	32	7.3	2,570	490	7	-	-	-	-	-	-	-	8.8	1.7	-
April 24	46	7.5	8,370	330	11	-	-	-	-	-	-	-	10.0	3.4	-
July 25	75	7.7	3,350	1,300	6	60	120	9.2	59	3.6	72	NF	7.4	2.6	-
Sept. 11	64	8.1	2,440	45	3.0	-	-	-	-	-	-	-	9.2	3.0	-
Oct. 23	56	8.8	**	78	7.0	-	-	-	-	-	-	-	9.5	3.6	2
Dec. 27	33	7.4	**	230	7.0	-	-	-	-	-	-	-	11	1.2	-

* Gaging station near St. Croix Falls, Wisconsin
** Flow readings not yet available
*** Gaging station near St. Croix Falls, Wisconsin

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St. Louis River at Fond du Lac — Station SL-8

Date	Temp.	pH	Flow* cfs	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Jan. 12	33	7.5	1,340	4,900	8	-	-	-	-	-	-	-	9.9	12.0
May 14	53	7.1	6,030	35,000	12.0	-	-	-	-	-	-	-	7.3	6.6
June 7	68	7.3	1,760	-	11.0	-	-	-	-	-	-	-	2.4	5.8
Aug. 9	74	7.1	920	2,400,000	23.0	120	240	15	140	9.6	88	14.0	NF	11.0
Aug. 24	70	7.0	615	-	8.0	-	-	-	-	-	86	-	NF	13.0
Sept. 26	56	7.2	730	17,000	12.0	-	-	-	-	-	-	-	0.4	17.0
Nov. 29	33	7.3	**	450,000	11.0	-	-	-	-	-	-	-	7.2	20.0

Sauk River at Sauk Rapids — Station Sa-0

Date	Temp.	pH	Flow*** cfs	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
April 26	45	9.1	317	1,700	18	-	-	-	-	-	-	-	12.0	6.7
June 27	70	7.9	109	7,900	12	25	300	17	140	11	190	NF	8.8	2.4
Aug. 30	73	8.5	291	35,000	12	45	290	21	150	8.2	180	4.0	8.4	3.7
Oct. 3	58	8.5	127*****	2,000	7.0	-	-	-	-	-	-	-	9.7	4.5
Dec. 14	33	8.3	102*****	11,000	5.0	-	-	-	-	-	-	-	13.0	1.9

Shellrock River near Albert Lea — Station SR-13.3

Date	Temp.	pH	Flow**** cfs	Coliform Group	Turb.	DO	BOD
May 7	60	10.0	225	130	48	23.0	38.0
July 23	78	8.1	30	2,000	5.0	6.1	3.9
Sept. 12	66	9.9	22	200	7.0	8.7	10.0
Nov. 13	42	8.4	**	680	-	10.0	3.0

* Gaging station at Scanlon, Minnesota
** Flow readings not yet available
*** Gaging station near St. Cloud, Minnesota
**** Gaging station at Northwood, Iowa
*****Provisional readings

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Straight River near Clinton Falls — Station St-18

Date	Temp.	pH	Flow cfs	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Feb. 15	32	8.0	-	170,000	11.0	-	-	-	-	-	-	-	11.0	8.3
May 1	46	8.5	-	7,800	9.0	-	-	-	-	-	-	-	17.0	6.8
Aug. 28	78	7.5	-	240,000	36.0	39	270	51	100	17	110	10	1.8	11.0
Oct. 2	60	8.1	-	79,000	8.0	23	540	9.0	140	3.4	290	52	11.0	5.0
Nov. 20	37	8.1	-	33,000	12.0	-	-	-	-	-	-	-	9.7	4.1

Upper Mississippi River at Anoka — Station UM-14

Date	Temp.	pH	Flow cfs	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
April 26	44	8.5	17,100	3,500	19	-	-	-	-	-	-	-	11.0	4.1
June 27	70	7.7	6,720	92,000	27	70	410	71	170	21	170	NF	6.8	3.8
Aug. 30	74	8.4	5,160	4,900	13	45	280	26	140	10	190	3.0	7.2	5.5
Oct. 3	58	8.5	2720****	1,700	8.0	-	-	-	-	-	-	-	10.0	2.9
Dec. 14	33	8.1	2450****	3,300	3.5	-	-	-	-	-	-	-	15.0	2.1

Upper Mississippi River at Sauk Rapids — Station UM-68

Date	Temp.	pH	Flow*** cfs	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
April 26	43	8.0	14,200	1,700	20	-	-	-	-	-	-	-	11.0	3.3
June 27	71	8.0	1,980	24,000	19	40	250	22	130	12	150	NF	7.3	2.7
Aug. 30	74	8.5	1,540	7,900	8.0	37	220	15	120	8.8	160	NF	8.4	2.2
Oct. 3	58	8.5	**	3,300	6.0	-	-	-	-	-	-	-	11.0	2.7
Dec. 14	33	8.3	**	2,300	7.0	-	-	-	-	-	-	-	14.0	2.2

** Readings not yet available
*** Gaging station near Royalton, Minnesota
****Provisional readings

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Zumbro River, North Branch near Zumbrota — Station NBZ-72

Date	Temp.	pH	Flow cfs	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Feb. 15	33	7.5	-	55,000	7.0	-	-	-	-	-	-	-	4.4	>24
May 1	50	8.4	-	70,000	8.0	-	-	-	-	-	-	-	15.0	3.7
Aug. 28	72	8.0	-	350,000	5.5	30	380	9.5	140	7.5	230	NF	4.9	2.3
Oct. 2	54	8.0	-	79,000	7.0	19	380	7.4	120	3.4	260	6.0	5.4	2.0
Nov. 20	34	8.2	-	79,000	10	-	-	-	-	-	-	-	12.0	3.1

Zumbro River, North Middle Branch near Oronoco — Station NMBZ-9

Date	Temp.	pH	Flow cfs	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Feb. 15	32	8.0	-	4,500	8.0	-	-	-	-	-	-	-	10	3.1
May 1	48	8.5	-	49,000	8.0	-	-	-	-	-	-	-	14	3.6
Aug. 28	72	8.3	-	49,000	9.0	25	330	20	130	8	230	NF	8.2	3.5
Oct. 2	56	8.3	-	2,000	7.0	17	290	7.4	92	3.0	230	NF	15	2.2
Nov. 20	35	8.2	-	49,000	12.0	-	-	-	-	-	-	-	11	>22

Zumbro River, South Branch near Rochester — Station SBZ-17

Date	Temp.	pH	Flow cfs	Coliform Group	Turb.	Color	TS	TSS	TVM	TSVM	Alk.	Cl	DO	BOD
Feb. 15	32	7.9	28	920,000	8	-	-	-	-	-	-	-	8.6	8.2
May 1	46	8.3	109	34,000	10	-	-	-	-	-	-	-	12.0	4.1
Aug. 28	74	8.2	42	170,000	7	24	390	18	130	10	240	10	9.3	5.5
Oct. 2	56	8.1	**	240,000	7	19	380	8.4	110	3.6	260	28	10	2.5
Nov. 20	39	8.0	**	220,000	12	-	-	-	-	-	-	-	9.2	6.4

** Flow readings not yet available

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Big Cottonwood River near New Ulm

Station BC-5.3

Date	Temp.	pH	Flow** (cfs)	Coliform Group	TS	TVM	Turb.	Alk.	Cl	DO	BOD	Radiological Analysis Dissolved Solids Beta µµ c/l
March 5	33	7.7		2,700	1,800	440	230	340	18.0	6.5	24.0	45
April 17	60	8.3		92,000	-	-	15	-	-	12.0	6.6	18.5
June 26	67	7.9		>24,000	-	-	140	-	-	7.2	5.0	178.5
Aug. 7	74	7.9		13,000	-	-	35	-	-	7.3	6.8	47
Sept. 18	65	7.7		1,700	-	-	27	-	-	9.2	5.8	51
Oct. 29	43	7.9		1,700	730	-	30	-	-	9.2	3.3	68
Dec. 3	32	-		1,700	-	-	10	-	-	13.0	2.0	31

Blue Earth River near Winnebago

Station BE-63

Date	Temp.	pH	Flow** (cfs)	Coliform Group	TS	Turb.	DO	BOD	Radiological Analysis Dissolved Solids Beta µµ c/l
March 7	34	8.1		4,500	-	8.0	14.0	4.1	32
May 9	60	7.5		13,000	-	26.0	7.9	12.0	-
June 19	73	7.6		17,000	-	54.0	9.4	8.0	-
July 16	76	7.6		130,000	-	240.0	7.3	11.0	-
Aug. 13	79	7.8		540,000	-	72.0	9.0	11.0	120
Sept. 25	70	8.0		20,000	-	18.0	16.0	14.0	61
Nov. 5	43	7.6		79,000	730	17.0	9.4	6.0	46
Dec. 10	32	7.4		14,000	720	10.0	11.0	2.8	14

Blue Earth River near Blue Earth

Station BE-84

Date	Temp.	pH	Flow** (cfs)	Coliform Group	TS	Turb.	DO	BOD	Radiological Analysis Dissolved Solids Beta µµ c/l
March 7	34	8.1		2,300	-	6.0	9.0	4.5	I.F.B.
May 9	60	7.1		17,000	-	37.0	6.5	15.0	-
June 19	74	7.4		13,000	-	54.0	11.0	14.0	-
July 16	78	8.0		920,000	-	36.0	7.1	11.0	178
Aug. 13	82	7.6		-	-	10.0	13.0	13.0	160
Sept. 25	69	8.1		7,800	-	10.0	14.0	4.8	60
Nov. 5	43	7.8		4,500	610	14.0	12.0	4.7	53
Dec. 10	32	7.6		17,800	600	12.0	10.0	2.8	19

** Flow readings are not yet available.

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Crow River at Dayton — Station Cr-0

Date	Temp.	pH	Flow* (cfs)	Coliform Group	TS	Turb.	DO	BOD	Radiological Analysis Dissolved Solids Beta μμ c/l
Feb. 28	33	7.9	64****	2,300	-	5.0	11.0	0.4	I.F.B.
April 16	44	8.3	915****	3,300	-	12.0	13.0	5.5	I.F.B.
May 28	59	8.3	1230****	7,000	-	32.0	8.1	6.1	-
July 23	76	7.7	2680****	24,000	-	28.0	6.6	5.9	143.0
Sept. 9	66	7.4	4030****	13,000	-	22.0	6.2	2.0	127.0
Oct. 22	49	7.9	**	4,900	170	17.0	9.4	3.0	I.F.B.
Nov. 26	32	8.4	**	7,900	430	12.0	13.0	4.1	23
Dec. 18	32	8.0	**	3,300	460	7.0	12.0	5.3	56

Crow River at Rockford — Station Cr-40

Date	Temp.	pH	Flow (cfs)	Coliform Group	TS	Turb.	DO	BOD	Radiological Analysis Dissolved Solids Beta μμ c/l
April 16	49	8.5	915****	2,300	-	15.0	14.0	7.1	24
May 28	64	8.6	1230****	4,600	-	35.0	8.1	6.1	-
June 26	68	7.6	13500****	>24,000	-	45.0	5.1	5.0	204.8
July 23	78	7.9	2680****	24,000	-	29.0	4.7	5.1	176.6
Sept. 9	65	7.4	4030****	13,000	-	16.0	5.4	4.0	128.0
Oct. 22	50	7.9	**	4,900	180	19.0	7.8	4.0	74.0
Nov. 26	32	8.0	**	7,900	410	12.0	12.0	4.5	35.0
Dec. 18	34	7.8	**	7,900	390	7.0	11.0	4.0	13

Crow River at Watertown — Station Cr-59

Date	Temp.	pH	Flow* (cfs)	Coliform Group	TS	Turb.	DO	BOD	Radiological Analysis Dissolved Solids Beta μμ c/l
April 16	50	8.6	915****	13,000	-	15.0	14.0	8.5	24.5
May 28	63	8.0	1230****	35,000	-	35.0	8.2	7.4	-
June 26	68	7.8	13500****	5,400	-	51.0	5.3	3.8	187.1
July 23	78	7.8	2680****	35,000	-	37.0	5.3	9.1	183.0
Sept. 9	65	7.6	4030****	3,300	-	26.0	5.6	4.5	152.0
Oct. 22	50	8.0	**	24,000	260	26.0	8.7	5.0	110.0
Nov. 26	32	8.2	**	35,000	600	12.0	9.8	4.8	43.0
Dec. 18	34	7.7	**	7,900	670	7.0	10.0	5.6	35.0

*Gaging Station at Rockford, Minnesota
**Flow readings are not yet available

****Provisional Reading

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Crow River near Biscay

Station Cr-66

Date	Temp.	pH	Flow** (cfs)	Coliform Group	TS	Turb.	DO	BOD	Radiological Analysis Dissolved Solids Beta µµ c/l
April 16	48	8.6		3,300	-	12.0	14.0	3.1	I.F.B.
May 28	67	8.4		24,000	-	20.0	9.7	8.5	-
June 26	69	7.9		5,400	-	39.0	6.3	3.8	133.0
July 23	80	7.9		24,000	-	37.0	5.9	8.1	145.1
Sept. 9	67	7.6		17,000	-	34.0	6.0	2.8	178.0
Oct. 22	50	8.0		54,000	250	35.0	8.2	5.0	90.0
Nov. 26	32	8.0		35,000	630	12.0	11.0	5.8	23.0
Dec. 18	36	8.4		49,000	650	7.0	10.0	7.8	31.0

Des Moines River near Jackson

Station DM-8.3

Date	Temp.	pH	Flow (cfs)	Coliform Group	TS	Turb.	DO	BOD	Radiological Analysis Dissolved Solids Beta µµ c/l
Jan. 9	32	8.6	1.6****	140,000	700	9	13.0	5.0	18.0
March 7	33	8.0	4.4****	160,000	-	12	4.6	13.0	-
May 9	58	8.0	27 ****	54,000	-	18	5.7	6.2	-
June 19	66	7.6	125 ****	24,000	-	150	6.8	6.1	-
Aug. 8	75	8.0	154 ****	92,000	-	42	7.4	8.2	88.0
Sept. 19	60	8.0	109 ****	54,000	-	90	6.3	7.8	96.0
Oct. 30	43	7.8	**	24,000	560	12	10	3.3	22.0
Dec. 4	32	-	**	35,000	-	9	11	3.2	47.0

Des Moines River near Jackson

Station DM-18

Date	Temp.	pH	Flow (cfs)	Coliform Group	TS	Turb.	DO	BOD	Radiological Analysis Dissolved Solids Beta µµ c/l
Jan. 9	32	8.3	1.6****	7,800	1,000	9.0	15.0	3.5	34.0
March 7	33	8.2	4.4****	450	-	6.0	12.0	4.3	I.F.B.
May 9	60	8.1	2,7****	3,300	-	23.0	5.7	6.6	-
June 19	68	7.7	125****	4,900	-	130	6.5	5.4	-
Aug. 8	74	8.1	154****	4,900	-	44	7.2	9.0	110.0
Sept. 19	61	8.1	109****	4,600	-	110	6.3	7.5	108.0
Oct. 30	43	7.8	**	13,000	580	16	11.0	4.0	53.0
Dec. 4	32	-	**	92,000	-	20	11.0	3.0	23.0

**Flow Readings are not yet available

****Provisional Readings

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Lower Mississippi River at Fridley — Station LM-1

Date	Temp.	pH	Flow* (cfs)	Coliform Group	TS	Turb.	DO	BOD	Radiological Analysis Dissolved Solids Beta µµ c/l
Feb. 28	33	7.8	2550****	7,000	-	5.0	8.6	.4	I.F.B.
April 16	44	8.2	8300****	2,300	-	9.0	12.0	3.5	I.F.B.
May 28	58	7.3	12500****	3,300	-	10	9.4	6.4	-
June 25	67	7.7	40200****	>24,000	-	29	7.7	4.5	121
July 24	76	7.3	37400****	11,000	-	13	7.2	2.9	135.3
Sept. 9	67	7.0	14400****	7,900	-	13	6.8	3.8	106
Oct. 22	49	7.8	**	780	240	10	9.0	3.3	74
Nov. 19	32	7.9	**	200	-	4	-	1.0	60
Nov. 25	32	8.9	**	13,000	260	10	13.0	2.3	33
Dec. 17	32	8.0	**	2,300	270	7	12.0	2.6	43
Dec. 31	32	8.0	**	1,700	410	7	12.0	3.0	36

Minnesota River near Shakopee (***Gauging Station at Carver, Minnesota) — Station Mi-16.8

Date	Temp.	pH	Flow*** (cfs)	Coliform Group	TS	Turb.	DO	BOD	Radiological Analysis Dissolved Solids Beta µµ c/l
March 5	34	8.1	296****	79,000	-	18.0	20.0	12.0	I.F.B.
April 17	48	8.3	2220****	13,000	-	36.0	12.0	9.2	15.0
June 26	66	7.5	40200****	24,000	-	170.0	3.8	9.0	88.1
Aug. 7	72	7.7	4510****	54,000	-	84.0	6.9	9.3	210
Sept. 18	62	7.4	3170****	46,000	-	52.0	7.0	3.8	75
Oct. 29	44	8.0	**	49,000	620	45.0	7.1	5.0	96
Dec. 3	32	-	**	13,000	700	11.0	12.0	2.5	35

Minnesota River near Jordan (***Gauging Station at Carver, Minnesota) — Station Mi-39

Date	Temp.	pH	Flow*** (cfs)	Coliform Group	TS	Turb.	DO	BOD	Radiological Analysis Dissolved Solids Beta µµ c/l
March 5	34	7.9	296****	7,800	-	14.0	15	8.3	I.F.B.
April 17	50	8.3	2220****	4,900	-	34.0	13.0	8.2	29
June 26	67	7.8	40200****	>24,000	-	170.0	5.8	7.2	95.7
Aug. 7	73	8.0	4510****	17,000	-	84.0	7.5	8.3	200.0
Sept. 18	63	7.6	3170****	13,000	-	51.0	6.6	3.3	80.0
Oct. 29	44	8.0	**	11,000	610	35.0	7.4	4.0	73.0
Dec. 3	32	-	**	4,900	730	16.0	12.0	3.8	59.0

*Gaging Station at Anoka, Minnesota **Flow readings are not yet available ****Provisional Readings

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Minnesota River at Henderson — Station Mi-70

Date	Temp.	pH	Flow** (cfs)	Coliform Group	TS	Turb.	DO	BOD	Radiological Analysis Dissolved Solids Beta μμ c/l
March 5	34	7.7		7,800	-	13.0	13.0	9.2	13.0
April 17	50	8.4		13,000	-	35.0	12.0	9.0	1.F.B.
June 26	68	7.7		>24,000	-	150.0	6.2	5.6	123.0
Aug. 7	73	7.5		49,000	-	78.0	7.2	12.0	160
Sept. 18	63	7.9		49,000	-	60.0	7.3	3.8	62
Oct. 29	44	7.9		17,000	620	37.0	8.1	4.0	104
Dec. 3	32	-		17,000	750	15	12.0	2.8	15.0

Minnesota River at St. Peter — Station Mi-97

Date	Temp.	pH	Flow** (cfs)	Coliform Group	TS	Turb.	DO	BOD	Radiological Analysis Dissolved Solids Beta μμ c/l
March 5	34	8.1		49,000	-	11.0	18.0	9.6	11.0
April 17	50	8.4		49,000	-	26.0	13.0	10.0	21.0
June 26	68	7.8		>24,000	-	140.0	6.5	4.5	144.0
Aug. 7	73	8.0		46,000	-	84.0	7.6	8.0	250
Sept. 18	64	7.8		240,000	-	57.0	6.3	3.8	96.0
Oct. 29	44	8.1		49,000	610	40.0	9.1	2.5	42.0
Dec. 3	32	-		32,000	780	15.0	11.0	2.5	41.0

Minnesota River near Courtland — Station Mi-129

Date	Temp.	pH	Flow** (cfs)	Coliform Group	TS	Turb.	DO	BOD	Radiological Analysis Dissolved Solids Beta μμ c/l
March 17	50	8.4		17,000	-	25	12.0	8.4	47
Aug. 7	73	8.0		27,000	-	84	7.1	6.5	390
Sept. 18	63	7.9		14,000	-	63	7.4	4.5	90
Oct. 29	43	8.0		7,800	480	34	8.6	3.8	97
Dec. 3	32	-		2,300	810	12	12.0	2.8	53

**Flow readings are not yet available

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Minnesota River at New Ulm — Station mi-142

Date	Temp.	pH	Flow** (cfs)	Coliform Group	TS	Turb.	DO	BOD	Radiological Analysis Dissolved Solids Beta μμ c/l
April 17	48	8.4		780	-	21	12.0	7.8	67
Aug. 7	74	3.0		7,900	-	78	7.5	6.5	280
Sept. 18	63	7.9		2,300	-	54	7.6	3.8	76
Oct. 29	43	8.0		7,900	320	30	9.3	3.8	95
Dec. 3	32	-		3,300	780	13	13.0	3.0	64

Otter Tail River at Breckenridge — Station OT-1

Date	Temp.	pH	Flow* (cfs)	Coliform Group	TS	Turb.	DO	BOD	Radiological Analysis Dissolved Solids Beta μμ c/l
Jan. 29	33	7.9	139****	450	-	6.0	11.0	3.0	89
April 23	55	8.4	578****	2,200	-	44	10.0	3.9	17.5
June 4	70	8.3	704****	1,700	-	27	8.7	3.1	-
Aug. 1	79	8.0	488****	4,900	-	60	6.9	4.3	390
Oct. 9	48	7.8	**	2,300	260	15	10.0	-	84
Nov. 20	33	8.0	**	400	260	16	12.0	2.5	35

Red River at Grand Forks, North Dakota — Station re-6

Date	Temp.	pH	Flow (cfs)	Coliform Group	TS	Turb.	DO	BOD	Radiological Analysis Dissolved Solids Beta μμ c/l
Jan. 30	33	7.3	410****	130,000	-	7.0	9.1	3.6	-
April 24	53	7.9	4050****	33,000	-	500	6.6	7.1	44.0
June 5	66	8.1	2280****	13,000	-	30	8.5	3.3	-
July 31	80	8.0	3580****	70,000	-	78	7.3	3.3	690
Oct. 8	53	7.5	3000****	23,000	370	36	8.5	3.5	230
Nov. 19	33	8.0	3220****	49,000	-	34	12.0	4.5	46

*Gaging Station near Fergus Falls, Minnesota
**Flow readings are not yet available
****Provisional Reading

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Rock River near Luverne — Station Ro-17

Date	Temp.	pH	Flow** (cfs)	Coliform Group	TS	Turb.	DO	BOD	Radiological Analysis Dissolved Solids Beta μμ c/l
March 7	33	8.0		11,000	-	15	7.2	10.3	62
May 9	54	8.3		1,700	-	20	7.7	5.7	-
June 19	64	7.4		>24,000	-	410	6.1	6.2	-
Aug. 8	72	8.0		3,300	-	35	7.3	9.0	91
Sept. 19	60	7.8		7,000	-	81	5.9	6.3	146
Oct. 30	40	8.0		1,100	470	15	8.3	3.8	28
Dec. 4	32	-		400	550	13	12.0	2.0	I.F.B.

Rum River at Anoka — Station Ru-0

Date	Temp.	pH	Flow* (cfs)	Coliform Group	TS	Turb.	DO	BOD	Radiological Analysis Dissolved Solids Beta μμ c/l
Feb. 28	34	7.5	138****	4,900	-	5.5	9.9	0.9	I.F.B.
April 30	64	7.7	1020****	1,300	-	12.0	7.4	3.3	13.0
June 25	65	8.0	4680****	5,400	-	14.0	6.3	4.2	97.8
July 23	77	8.3	1270****	17,000	-	14.0	8.1	3.9	83.5
Sept. 9	66	7.3	1820****	3,300	-	14.0	6.7	4.0	82.0
Oct. 22	48	8.1	**	1,300	210	11.0	9.9	2.8	55.0
Nov. 25	32	8.2	**	4,900	210	11.0	12.0	3.3	35.0
Dec. 17	32	8.0	**	3,300	240	7.0	12.0	2.5	25.0

Rum River at Isanti — Station Ru-34

Date	Temp.	pH	Flow* (cfs)	Coliform Group	TS	Turb.	DO	BOD	Radiological Analysis Dissolved Solids Beta μμ c/l
Feb. 28	34	7.6	138****	17,000	-	6.0	3.15	1.3	I.F.B.
April 30	62	7.7	1020****	2,200	-	11.0	8.1	4.3	I.F.B.
June 25	67	7.4	4680****	9,200	-	13.0	4.2	3.2	199
July 24	72	7.4	1160****	35,000	-	17.0	5.1	8.9	136.5
Sept. 10	64	7.5	1600****	7,900	-	14.0	5.5	4.5	87
Oct. 23	48	7.7	**	54,000	220	12	8.8	4.1	59
Dec. 17	32	7.7	**	7,800	240	9.0	9.1	3.0	13

*Gaging Station near St. Francis, Minnesota

**Flow readings are not yet available

****Provisional Records

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Rum River at West Point — Station Ru-61

Date	Temp.	pH	Flow* (cfs)	Coliform Group	TS	Turb.	DO	BOD	Radiological Analysis Dissolved Solids Beta μμ c/l
Feb. 28	33	7.6	138****	200	-	10	4.7	<0.1	I.F.B.
April 30	62	7.7	1020****	2,300	-	10	7.8	3.9	12.0
June 25	65	7.6	4680****	16,000	-	14	5.7	3.3	169.5
July 24	74	7.8	1160****	4,600	-	21	6.6	8.5	269.0
Sept. 10	64	7.6	1600****	11,000	-	14	5.4	2.5	88.0
Oct. 23	48	7.6	**	13,000	210	11	9.2	1.3	67
Dec. 17	32	8.1	**	4,900	240	7	9.6	1.8	26

Rum River near Pease — Station Ru-102

Date	Temp.	pH	Flow* (cfs)	Coliform Group	TS	Turb.	DO	BOD	Radiological Analysis Dissolved Solids Beta μμ c/l
Feb. 28	33	7.4	138****	1,300	-	10	0.5	1.8	17.0
April 30	64	8.0	1020****	33,000	-	7.5	9.9	4.0	15.0
June 25	65	7.7	4680****	>24,000	-	8.0	7.1	3.7	96.4
July 24	71	7.6	1160****	54,000	-	15.0	6.2	4.5	156.1
Sept. 10	62	7.6	1600****	7,900	-	10.0	7.8	2.8	77
Oct. 23	47	7.7	**	2,300	180	8.0	9.1	2.0	86
Dec. 17	32	8.0	**	7,000	280	7.0	9.4	2.8	19

St. Croix River at Prescott — Station SC-0

Date	Temp.	pH	Flow** (cfs)	Coliform Group	TS	TVM	TSS	TSVM	Turb.	Color	Alk.	DO	BOD	Radiological Analysis Dissolved Solids Beta μμ c/l
April 9	41	7.7		780					7.0			9.7	3.5	I.F.B.
April 30	60	8.2		490	110	44	19	10	5.0	55	58	12.0	1.9	13
June 11	67	8.2		200	160	22	15	3.2	6.0	60	74	9.1	3.5	-
July 1	71	7.5		330	140	83	9	9	10	75	68	6.7	3.7	44
July 24	80	7.4		330	160	79	28	14	12	10.5	72	5.5	5.1	130
Sept. 30	66	7.3		200	170	60	45	45	13	57	110	6.9	3.5	18
Oct. 23	59	7.7		450	180	63	18	16	10	35	170	7.4	2.8	25
Dec. 12	32	8.1		1,300	120	120	18	18	6	40	86	14.0	1.5	I.F.B.

*Gaging Station near St. Francis, Minnesota **Flow readings are not yet available ****Provisional Readings

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St. Croix River at Stillwater — Station SC-22.6

Date	Temp.	pH	Flow** (cfs)	Coliform Group	TS	Turb.	DO	BOD	Radiological Analysis Dissolved Solids Beta μμ c/l
April 9	41	7.8		2,300	-	10	12.0	4.0	15.3
June 11	70	8.0		22,000	-	14	7.6	6.3	-
July 1	72	8.0		3,300	-	11	5.9	4.7	42.0
July 24	77	7.2		4,600	-	12	5.5	3.8	160.0
Sept. 30	60	7.0		2,300	-	16	8.2	3.3	39.0

St. Croix River at Osceola, Wisconsin — Station SC-45

Date	Temp.	pH	Flow** (cfs)	Coliform Group	Turb.	Alk.	DO	BOD	Radiological Analysis Dissolved Solids Beta μμ c/l
June 11	67	7.8		2,200	12	-	7.4	2.8	-
July 1	73	8.0		3,300	15	-	7.4	4.3	38.0
July 24	75	7.6		3,300	13	-	7.1	3.8	140.0
Sept. 30	59	7.0		24,000	10	-	8.2	1.5	49.0

St. Croix River at Taylor Falls — Station SC-51.8

Date	Temp.	pH	Flow** (cfs)	Coliform Group	TS	Turb.	DO	BOD
Feb. 9	32	8.0		330	-	7.2	9.1	0.70
April 18	53	8.0		170	-	13.0	9.7	2.0
May 19	72	8.3		490	-	13.0	10.0	2.4
June 15	70	8.0		230	-	14.0	7.5	1.9
Aug. 3	81	7.0		170	-	20.0	4.0	2.0
Oct. 13	58	6.6		78	-	15.0	8.0	3.2

**Flow readings are not yet available

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St. Croix River near Danbury

Station SC-111

Date	Temp.	pH	Flow** (cfs)	Coliform Group	TS	TSS	TVM	TSVM	Turb.	Color	Alk.	Cl	DO	BOD	Radiological Analysis Dissolved Solids Beta μμ c/l
April 30	64	7.8		490	100	47	50	9.6	9.0	-	46	-	9.0	2.3	I.F.B.
June 11	61	8.7		780	120	21	14	8.4	9.0	32	56	-	7.8	2.8	-
July 1	62	7.5		230	120	14	71	13	10.0	50	56	-	8.1	3.6	44
Aug. 24	72	7.4		1,100	160	30	67	20	10.0	120	36	-	7.0	5.0	130
Sept. 30	59	6.9		200	120	54	61	54	11.0	45	94	-	7.3	3.5	32

St. Louis River near Brookston

Station SL-1

Date	Temp.	pH	Flow** (cfs)	Coliform Group	TS	Turb.	DO	BOD	Radiological Analysis Dissolved Solids Beta μμ c/l
Jan. 31	33	7.0		170	-	16.0	9.2	3.0	380
April 25	52	7.3		200	-	48.0	6.9	3.9	I.F.B.
June 6	60	7.6		780	-	9.0	8.6	3.5	-
July 30	77	7.4		450	-	12.0	4.1	2.8	130.0
Oct. 7	55	6.6		200	135	10.0	7.6	3.0	200
Nov. 18	32	7.2		780	110	11.0	12.0	2.0	24.0

St. Louis River at Cloquet

Station SL-3

Date	Temp.	pH	Flow** (cfs)	Coliform Group	TS	Turb.	DO	BOD	Radiological Analysis Dissolved Solids Beta μμ c/l
Jan. 31	33	7.0		130,000	-	11.0	8.1	14.0	110.0
April 25	53	7.4		6,800	-	56.0	8.3	4.9	I.F.B.
June 6	63	7.4		110,000	-	11.0	7.6	8.3	-
July 30	75	7.5		79,000	-	17.0	2.8	5.2	110.0
Oct. 7	56	6.6		49,000	135	11.0	6.9	4.0	240.0
Nov. 18	32	7.0		7,800	140	9.0	10.0	3.5	42.0

**Flow readings are not yet available.

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St. Louis River at Scanlon

Station SL-4.5

Date	Temp.	pH	Flow** (cfs)	Coliform Group	TS	Turb.	DO	BOD	Radiological Analysis Dissolved Solids Beta μμ c/l
Jan. 31	33	6.9		240,000	-	20.0	5.1	30.0	40.0
April 25	54	7.3		6,800	-	52.0	9.1	4.9	37.0
June 6	60	7.5		350,000	-	12.0	5.0	15.0	-
July 30	77	7.6		240,000	-	13.0	2.6	8.9	120.0
Oct. 7	57	6.5		23,000	150	12	5.6	3.8	110.0
Nov. 18	33	7.2		23,000	190	12.0	8.7	12.0	28.0

St. Louis River at Fond du Lac

Station SL-8

Date	Temp.	pH	Flow** (cfs)	Coliform Group	TS	Turb.	DO	BOD	Radiological Analysis Dissolved Solids Beta μμ c/l
Jan. 31	33	6.9		11,000	-	17.0	5.7	29.0	68.0
April 25	54	7.5		13,000	-	60.0	7.3	5.4	35.0
June 6	62	6.8		240,000	-	11.0	3.0	7.9	-
July 30	75	7.3		13,000	-	9.0	2.9	5.7	130.0
Oct. 7	57	6.6		7,800	210	12	6.3	13.0	130.0

Sauk River at Sauk Rapids

Station Sa-0

Date	Temp.	pH	Flow** (cfs)	Coliform Group	TS	Turb.	DO	BOD	Radiological Analysis Dissolved Solids Beta μμ c/l
Feb. 28	33	7.9		13,000	-	11.0	9.8	2.3	16.0
April 16	44	8.5		13,000	-	10.0	13.0	6.9	18.0
May 28	60	8.4		3,300	-	12.0	10.0	5.4	-
June 25	65	7.6		9,200	-	12.0	7.7	8.0	55.1
July 23	70	8.0		24,000	-	15.0	8.6	3.6	136.2
Sept. 9	65	7.8		11,000	-	12.0	7.6	3.5	117
Oct. 22	51	8.2		4,600	290	13.0	10.0	4.5	59.0
Nov. 25	32	8.3		13,000	320	11.0	13.0	3.5	33.0
Dec. 31	32	8.1		3,300	550	7.0	12.0	4.8	11.0

**Flow readings are not yet available.

WATER QUALITY SAMPLING PROGRAM
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Upper Mississippi River at Anoka — Station UM-14

Date	Temp.	pH	Flow* (cfs)	Coliform Group	TS	Turb.	DO	BOD	Radiological Analysis Dissolved Solids Beta µµ c/l
Feb. 13	32	-	2600****	--	250	-	-	-	I.F.B.
Feb. 28	33	7.7	2550****	13,000	-	5.5	6.7	.1	I.F.B.
April 16	43	8.2	8670****	2,200	-	12.0	12.0	5.2	I.F.B.
May 28	58	7.5	12500****	4,900	-	16.0	9.0	6.0	-
June 25	64	7.9	40200****	16,000	-	40.0	6.6	5.2	157.0
July 23	76	7.9	15100****	7,900	-	15.0	7.2	4.1	187.8
Sept. 9	66	7.2	14800****	7,900	-	14.0	6.1	7.0	26
Oct. 22	49	7.8	**	2,300	270	15.0	9.3	3.0	46
Nov. 25	32	8.9	**	4,900	310	12.0	13.0	2.0	21
Dec. 13	32	-	**	—	260	-	-	-	I.F.B.
Dec. 17	32	8.1	**	3,300	300	8.0	12.0	0.9	I.F.B.
Dec. 26	32	-	**	—	370	-	-	-	24
Dec. 31	32	7.9	**	7,900	410	7.0	11.0	2.8	I.F.B.

Upper Mississippi River at Elk River — Station UM-26.7

Date	Temp.	pH	Flow* (cfs)	Coliform Group	TS	Turb.	DO	BOD	Radiological Analysis Dissolved Solids Beta µµ c/l
Feb. 13	32	-	2600****	-	250	-	-	-	23
Feb. 28	34	7.8	2550****	3,300	-	6.5	7.5	0.4	I.F.B.
Dec. 13	32	-	**	-	250	-	-	-	38
Dec. 17	32	-	**	-	240	9.0	-	-	I.F.B.
Dec. 26	32	-	**	-	330	-	-	-	15
Dec. 31	32	7.7	**	-	370	-	-	-	23

*Gaging Station near Anoka, Minnesota.
**Flow readings are not yet available.
****Provisional Reading.

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Upper Mississippi River at Sauk Rapids — Station U[illegible]

Date	Temp.	pH	Flow** (cfs)	Coliform Group	TS	Turb.	DO	BOD	Radiological Analysis Dissolved Solids Beta µµ c/l
Feb. 28	33	7.7		35,000	-	6.0	5.3	1.4	12.0
April 16	42	8.2		7,900	-	8.0	15.0	3.5	I.F.B.
May 28	61	8.1		3,300	-	13.0	10.0	5.4	-
June 25	67	7.7		5,400	-	17.0	8.3	4.3	84.1
July 23	79	7.8		1,700	-	16.0	7.8	3.4	211.0
Sept. 9	65	7.7		1,100	-	14.0	7.1	3.0	106
Oct. 22	51	7.9		2,300	250	11.0	9.4	3.5	62
Nov. 25	32	8.4		7,000	210	12.0	13.0	3.0	27
Dec. 31	32	7.8		3,300	370	8	11.0	3.0	27

Zumbro River(North Branch) near Zumbrota — Station NBZ-72

Date	Temp.	pH	Flow** (cfs)	Coliform Group	TS	Turb.	DO	BOD	Radiological Analysis Dissolved Solids Beta µµ c/l
Feb. 13	33	8.0		31,000	-	7	6.4	7.5	<10
May 1	64	8.4		33,000	-	6	10	8.0	I.F.B.
June 12	67	8.0		540,000	-	18	4.2	12.0	-
July 17	70	7.4		240,000	-	330	6.1	6.0	464.2
Aug. 14	72	7.6*		240,000	-	130	5.1	6.0	140
Sept. 26	54	7.5		79,000	-	11	8.5	7.8	25
Dec. 11	32	7.8		350,000	570	11	9.8	5.0	I.F.B.

*Taken in the laboratory
**Flow readings are not yet available

SYMBOLS AND ABBREVIATIONS

BOD	5-Day Biochemical Oxygen Demand
cfs	Cubic feet per second
C_aCO_3	Calcium carbonate
CAR	County Aid Road
DO	Dissolved oxygen
°F	Degrees Fahrenheit
IFB	Indistinguishable from background
l	Liter
MPN/100 ml	Most probable number per 100 milliliters
$\mu\mu c/l$	micromicrocuries per liter
mg/l	Milligrams per liter
ml	Milliliter
NF	Not found
pH	The common logarithm of the reciprocal of the hydrogen ion concentration
SAR	State Aid Road
SH	State Highway
TS	Total Solids
TSS	Total Suspended Solids
TSVM	Total Suspended Volatile Matter
TVM	Total Volatile Matter
$<$	Less than
$>$	More than
USH	United States Highway

ANALYTICAL PROCEDURES

Alkalinity:

The samples are titrated with 0.02N sulfuric acid to a pH of 4.5. A pH meter is used to determine the end point. Reported as calcium carbonate in mg/l.

Biochemical Oxygen Demand:

The sample is diluted with distilled water fortified with mineral nutrients. The dissolved oxygen is determined with the polarograph before and after five days of incubation in the dark at 20°C. Reported as BOD in mg/l.

Coliform Group Density:

Five portions of the sample are planted in each of three or more series of tubes containing lactose broth. After 48 hours of incubation at 35°C, the number of tubes in which gas has appeared is recorded for each series, and the most probable number of coliform organisms present in the sample is determined by reference to statistical tables. Reported as the most probable number of organisms per 100 milliliters of sample.

Color:

Color intensity, or "depth" is determined by direct visual comparison with a series of standards containing different amounts of potassium choroplatinate and cobaltous chloride. Reported in standard color units.

Dissolved Oxygen:

This determination is made by the Winkler technique, where manganous sulfate is added to the sample and made to react with the dissolved oxygen by raising the pH with a strong base. The manganic hydroxide precipitate formed is put into solution and made to oxidize iodine to free iodine by the addition of sulfuric acid. These reactions are carried out in the field at the time of samples collection.

In the laboratory, the liberated iodine is titrated with standard sodium thiosulfate, using starch as an indicator. Reported as DO in mg/l.

Hardness:

Calcium and magnesium, which constitute the major part of the hardness

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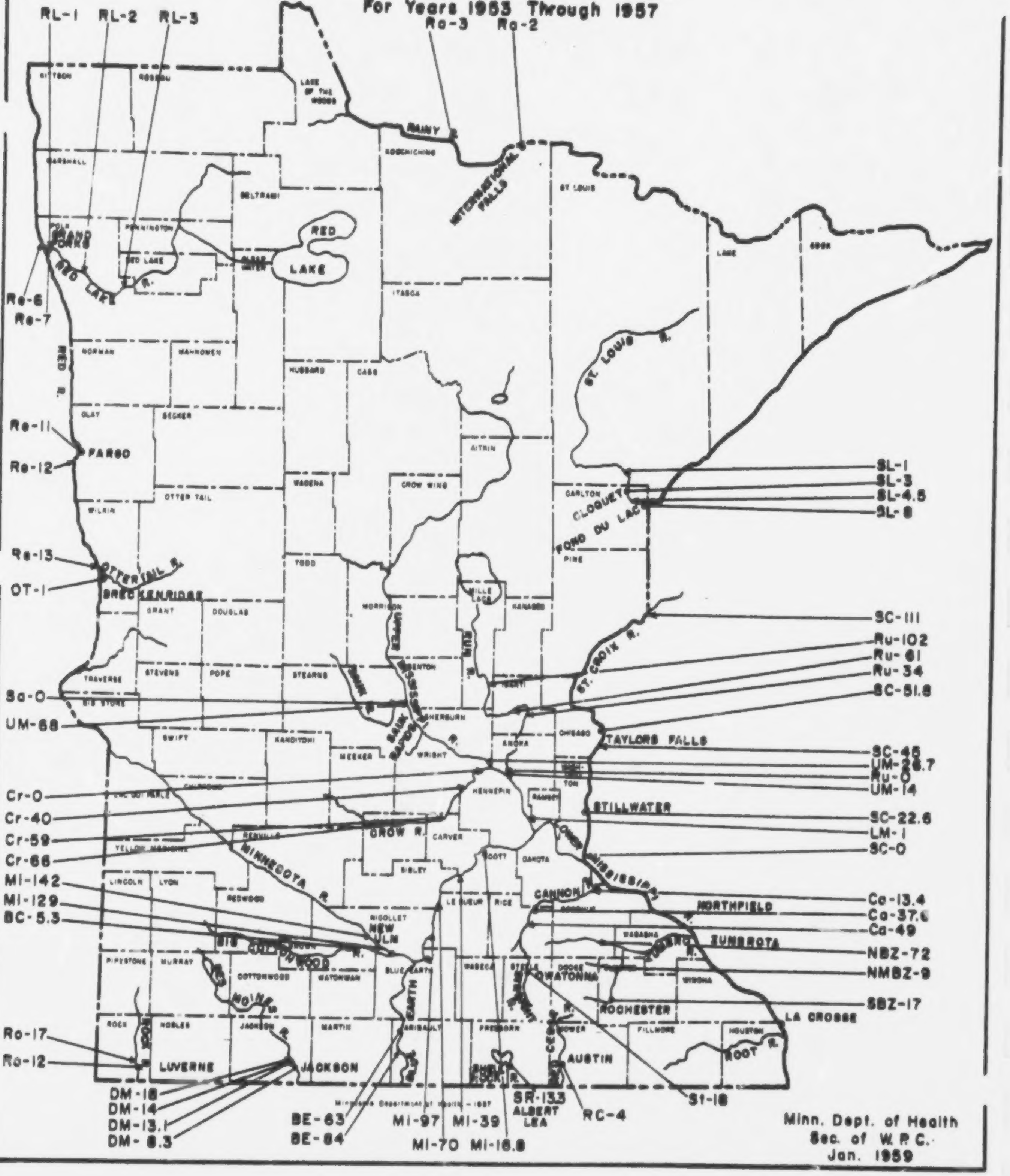
WATER QUALITY SAMPLING PROGRAM
GENERAL LOCATION OF STATIONS
For Years 1953 Through 1957



Minn. Dept. of Health
Sec. of W.P.C.
Jan. 1959

WATER QUALITY SAMPLING PROGRAM

a
compilation
of minnesota
sampling
station
records

MINNESOTA LAKES and STREAMS

VOLUME 2
1958-1959

BY THE SECTION OF WATER POLLUTION CONTROL
DIVISION OF ENVIRONMENTAL SANITATION
MINNESOTA DEPARTMENT OF HEALTH

931

WATER POLLUTION CONTROL COMMISSION

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MINNESOTA DEPARTMENT OF HEALTH
Division of Environmental Sanitation
Section of Water Pollution Control
(Technical and Administrative Agency
for the Commission)

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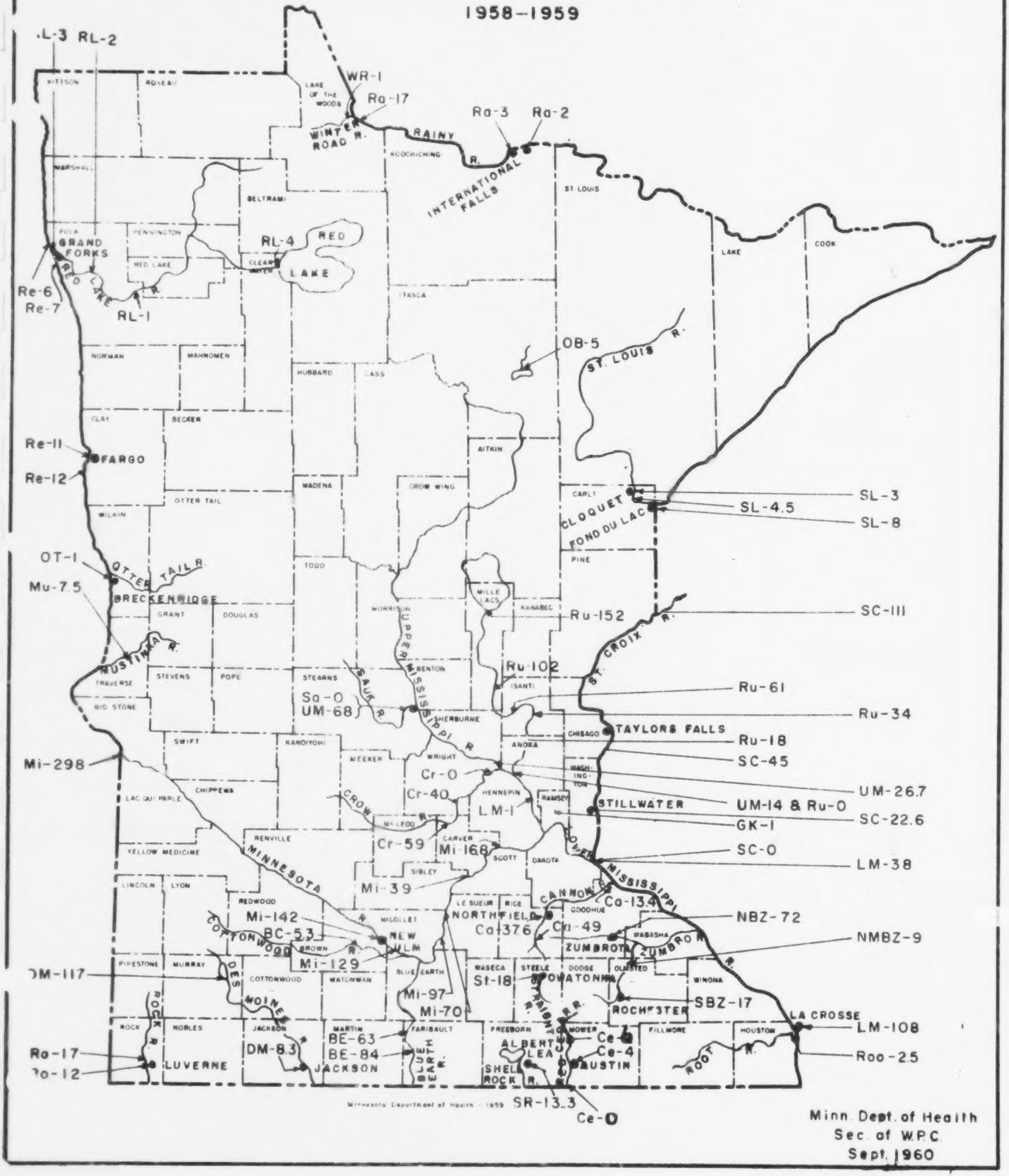
WATER QUALITY SAMPLING PROGRAM
GENERAL LOCATION OF STATIONS
1958–1959



Minn. Dept. of Health
Sec. of W.P.C.
Sept. 1960

COLLECTION OF SAMPLES

The water samples were collected by personnel of the Section of Water Pollution Control, generally by means of a double sampler. The double sampler is constructed to permit simultaneous collection of three separate samples, for dissolved oxygen, coliform bacteria and chemical analysis. Sampling was usually done from a bridge, or when necessary from a bank, by immersing the sampler to a depth of about one foot in the main flow of the stream.

Whenever possible, the samples obtained at each station were always collected at the same spot and as nearly as possible in the same part of the flow, in order to minimize changes caused by differences in sampling. The samples were preserved by icing and shipped promptly to the Department laboratory in Minneapolis for analysis.

The temperature and pH of the samples were measured in the field, and a record was also made of pertinent physical conditions at the time of sampling.

ANALYTICAL PROCEDURES

5-Day Biochemical Oxygen Demand:

The sample is diluted with distilled water fortified with mineral nutrients. The dissolved oxygen is determined with the polarograph before and after five days of incubation in the dark at 20°C. Reported as BOD in mg/l.

Coliform Group Organisms:

Five portions of the sample are planted in each of three or more series of tubes containing lactose broth. After 48 hours of incubation at 35°C, the number of tubes in which gas has appeared is recorded for each series, and the most probable number of coliform organisms present in the sample is determined by reference to statistical tables. Reported as the most probable number of organisms per 100 milliliters of sample.

Dissolved Oxygen:

This determination is made by the Winkler technique, where magnanous sulfate is added to the sample and made to react with the dissolved oxygen by raising the pH with a strong base. The manganic hydroxide precipitate formed is put into solution and made to oxidize iodide to free iodine by the addition of sulfuric acid. These reactions are carried out in the field at the time of sample collection.

In the laboratory, the liberated iodine is titrated with standard sodium thiosulfate, using starch as an indicator. Reported as DO in mg/l.

Nitrates:

The sample is concentrated by evaporation to dryness on a steam bath, the residue taken up in a small volume of an acetic acid-uranium acetate solution, and the nitrate determined directly with the polarograph. About 55% of the nitrites, usually present in negligible quantities, are included in the result obtained. Reported as nitrate nitrogen in mg/l.

pH:

A battery powered portable pH meter is used in the field. Reported in pH units.

Phosphorous:

The sample is evaporated to dryness in the presence of nitric acid to destroy organic matter. The residue is taken up with a sulfuric acid-molybdate solution, boiled to convert all phosphate to orthophosphate, diluted to volume and the phosphomolybdate complex reduced with stannous chloride. The color developed is read in a spectrophotometer. Reported as phosphorus in mg/l.

Radioactivity:

1. Suspended gross beta activity

The sample is filtered through a membrane filter and the residue on the filter washed into a planchet, dried, and counted for beta activity in either an internal proportional counter or an end window counter. Reported as suspended gross beta activity in micro-micro-curies per liter.

2. Dissolved gross beta activity

The filtrate from the suspended gross beta activity determination is evaporated to dryness in a planchet, and counted for beta activity. Reported as dissolved gross beta activity in micro-micro-curries per liter.

3. Total gross beta activity

Total gross beta activity is the sum of the suspended and the dissolved gross beta activity.

4. Suspended gross alpha activity

The sample is filtered through a membrane filter and the residue on the filter washed into a planchet, dried, and counted for alpha activity in an internal proportional counter. Reported as suspended gross alpha activity in micro-micro-curies per liter.

5. Dissolved gross alpha activity

The filtrate from the suspended gross alpha activity determination is evaporated to dryness in a planchet, and counted for alpha activity. Reported as dissolved gross alpha activity in micro-micro-curries per liter.

Temperature:

Determined in the field. Reported in °F.

Total Solids:

The sample is evaporated and the residue dried at 105°F to constant weight. Reported in mg/1.

Total Nitrogen:

Total nitrogen is the sum of the nitrogen obtained in the Kjeldahl nitrogen and nitrate nitrogen determinations. It includes the ammonia nitrogen, organic nitrogen, nitrate nitrogen and 55% of the nitrite nitrogen. The fraction of nitrite nitrogen not included can be ignored since its contribution to the total is very small. Reported as nitrogen in mg/1.

Turbidity:

Read from a Hellige turbidimeter which has been calibrated with a Jackson candle turbidimeter. Reported as turbidity units.

FLOW GAGING RECORDS

The records of stream discharge used in conjunction with the analytical data are published in U. S. Geological Survey reports on the surface water supply of the United States, although it will be noted that in some cases unpublished, provisional data have been used.

A detailed description of the gaging stations may be found in U.S.G.S. Water Supply Papers 1388, 1507, 1399 and 1280, Hudson Bay and Upper Mississippi River Basins, St. Lawrence River Basin, Missouri River Basin Above Sioux City, Iowa, and Missouri River Basin Below Sioux City, Iowa, respectively.

It should be noted that in a number of instances the flow was not gaged at the sampling station but at some other point on the river. In these instances, the data for the nearest gaging station are given and an explanatory note to this effect may be found under "Remarks."

SYMBOLS AND ABBREVIATIONS

5-Day BOD	5-Day Biochemical Oxygen Demand
cfs	Cubic feet per second
CAR	County Aid Road
DO	Dissolved Oxygen
°F	Degrees Farenheit
IFB	Indistinguishable from background
MPN/100 ml	Most probable number per 100 milliliters
uuc/l	Micromicrocuries per liter
mg/l	Milligrams per liter

NF	Not found
N	Nitrogen
pH	The common logarithm of the reciprocal of the hydrogen ion concentration
P	Phosphorous
SAR	State Aid Road
SH	State Highway
<	Less than
>	More than
USH	United States Highway

Minnesota River Basin
Big Cottonwood River

LOCATION: New Ulm; Bridge on SAR 3 above Flandreau State Park STATION: BC-5.3
RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, Minnesota Department of Health
REMARKS: Flow data not yet available

CHEMICAL ANALYSIS IN MILLIGRAMS PER LITER, 1958-59

Date	Temp. (°F)	pH	Coliform Group (MPN/100 ml)	Total Solids	Turbidity Value	Phosphorus (P)	Nitrates (N)	Total Nitrogen (N)	Dissolved Oxygen (DO)	Biochemical Oxygen Demand (5-Day BOD)
1-8-58	32	7.5	3,300	700	13				13.	2.9
2-17-58	32	7.9	2,300	580					5.1	2.8
4-16-58	62	8.0	54,000		60				8.1	5.2
6-3-58	66	7.7	540,000	1,200	360	0.88	0.56	4.6	6.9	5.5
6-25-58	67	8.3	2,000	640	20	0.15	0.12	2.1	11.	16.0
7-29-58	69	7.4	1,100		53				8.0	11.0
8-13-58	78	7.5	2,700		60				7.2	8.6
9-24-58	76	7.3	200		25				7.1	12.
10-30-58	50	7.6	5,400	650	50	0.32		1.6	13.	15.
4-1-59	52		13,000	700	23	0.22	2.0	3.7	9.3	5.0
5-19-59	66	7.8	1,700	900	26	0.44	0.20	1.7	9.7	8.5
6-18-59	74	8.1	14,000	770	22	0.22	0.40	1.0	5.4	6.5
11-19-59	34	7.4	7,900	890	14	0.12	2.1	3.1	12	1.5

Minnesota River Basin
Blue Earth River

LOCATION: Blue Earth; Bridge at Golf Course 5 miles north of town STATION: BE-84
RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, Minnesota Department of Health
REMARKS: Flow data not yet available

CHEMICAL ANALYSIS IN MILLIGRAMS PER LITER, 1958-59

Date	Temp. (°F)	pH	Coliform Group (MPN/100 ml)	Total Solids	Turbidity Value	Phosphorus (P)	Nitrates (N)	Total Nitrogen (N)	Dissolved Oxygen (DO)	Biochemical Oxygen Demand (5-Day BOD)
1-9-58	32	8.3	7,000	880	11				8.0	3.0
1-29-58	32	7.8	7,900	740	10				2.2	1.8
4-15-58	60	8.2	3,300	440	18				12.	5.5
6-2-58	64	7.6	11,000	580	44	0.34	NF	1.4	5.7	3.3
6-24-58	67	7.7	540,000	1,100	210	0.70	3.0	7.7	4.9	7.5
7-28-58	70	8.0	22,000		23				6.5	5.9
8-11-58	86	8.0	780		16				14.	9.0
9-23-58	75	7.0	2,000		15				16.	7.1
10-29-58	48	7.2	1,100	880	15	0.70		1.2	10.	2.8
12-9-58	31	7.6	1,700	1,200	5	0.44	0.08	3.3	2.1	3.9
3-31-59	36	7.1	17,000	410	32	0.34	3.1	5.5	9.2	6.0
5-18-59	64	7.5	1,700	670	23	0.42	1.1	2.7	7.3	3.3
6-17-59	74	8.1	24,000	600	21	0.47	0.3	1.1	5.0	2.8
11-18-59	34	7.3	24,000	660	8	0.24	3.6	4.5	12.	1.5

Minnesota River Basin
Blue Earth River

LOCATION: Winnebago; Bridge on CAR 2 which continues east from CAR 136 for ½ mile to the river
RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, Minnesota Department of Health
REMARKS: Flow data not yet available

STATION: BE-63

CHEMICAL ANALYSIS IN MILLIGRAMS PER LITER, 1958-59

Date	Temp. (°F)	pH	Coliform Group (MPN/100 ml)	Total Solids	Turbidity Value	Phosphorus (P)	Nitrates (N)	Total Nitrogen (N)	Dissolved Oxygen (DO)	Biochemical Oxygen Demand (5-Day BOD)
1-9-58	32	8.1	33,000	950	13				16.	3.0
1-29-58	32	8.2	79,000	800	12				5.5	4.0
4-15-58	59	8.2	2,000	490	30				10.	7.5
6-2-58	66	7.8	6,400	720	100	0.45		1.8	6.3	2.8
6-24-58	66	8.0	350,000	1,000	200	0.76	1.3	4.7	4.8	8.3
7-28-58	69	7.7	4,500		20				12.	8.1
8-11-58	86	6.8	2,300		17				10.	11.
9-23-58	71	7.8	2,000		22				13	9.3
10-29-58	53	7.1	3,300	950	10	0.67		0.72	15.	3.0
12-9-58	31	7.3	92,000	1,300	5	0.35	0.20	1.6	8.8	2.8
2-16-59	30	6.4	200	970	14	1.30	<0.02	3.2	0.4	3.0
3-31-59	38	7.8	3,300	400	32	0.36	2.7	4.6	7.4	4.3
5-18-59	64	7.6	2,200	760	29	0.62	1.2	3.8	7.7	5.3
6-17-59	74	8.2	3,100	600	29	0.37	0.8	2.0	4.6	5.3
11-18-59	35	7.6	11,000	710	12	1.8	4.2	5.1	10.	1.8

Lower Mississippi River Basin
Cannon River

LOCATION: Northfield; 1mile N.E. on SAR 3 from the junction of U.S. Highway 3 to first road to S.E., and S.E. to bridge on river
RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, Minnesota Department of Health
REMARKS: Provisional flow data from gaging station at Welch

STATION: Ca-37.6

CHEMICAL ANALYSIS IN MILLIGRAMS PER LITER, 1958-59

Date	Temp. (°F)	pH	Flow (cfs)	Coliform Group (MPN/100 ml)	Total Solids	Turbidity Value	Phosphorus (P)	Nitrates (N)	Total Nitrogen (N)	Dissolved Oxygen (DO)	Biochemical Oxygen Demand (5-Day BOD)
1-29-58	32	8.3	190	350,000	400	10				11.	4.8
4-8-58	43	8.1	471	70,000		46				9.0	10.
4-30-58	49	8.3	554	33,000	360	8				11.	6.3
5-12-58	67	8.5	310	23,000		16				8.7	3.5
6-18-58	66	7.3	233	33,000	560	23	0.56		2.7	7.2	6.0
7-22-58	68	8.3	169	2,000		120				19.	24.
8-26-58	58	6.8	135	92,000		32				7.5	11.
10-8-58	58	6.6	187	160,000	350	30	0.20	1.0	3.1	4.4	11.
11-18-58	37	6.8	156	240,000	420	12	0.42	1.6	2.3	8.9	2.8
2-9-59	35	5.8	130	33,000	790	3	1.6	3.0	5.7	6.0	4.3
3-18-59	33	7.2	307	33,000	400	16		1.6	3.0	4.7	7.5
4-13-59	44	7.0	124	7,800	430	5	0.41	2.0	2.8	12.	4.0
8-3-59	75	8.6	98	79,000	560	50	0.68	0.08	4.0	11.2	735.
11-3-59	43	7.9		27,000	450	10	0.43	2.8	4.2	8.9	6.5

Lower Mississippi River Basin
Cannon River

LOCATION: Welch; Bridge on SAR 7
RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, Minnesota Department of Health
STATION: Ca-13.4
REMARKS: Provisional flow data

CHEMICAL ANALYSIS IN MILLIGRAMS PER LITER, 1958-59

Date	Temp. (°F)	pH	Flow (cfs)	Coliform Group (MPN/100 ml)	Total Solids	Turbidity Value	Phosphorus (P)	Nitrates (N)	Total Nitrogen (N)	Dissolved Oxygen (DO)	Biochemical Oxygen Demand (5-Day BOD)
1-30-58	32	8.3	134	2,000	370	11				12.	2.5
4-29-58	48	8.2	586	2,000		20				11.	9.5
6-26-58	69	8.0	185	7,900	380	15	0.07	1.8	2.8	9.7	5.5
7-21-58	67	7.1	165	3,300		100				7.2	3.0
8-27-58	69	6.4	136	43,000		27				8.0	5.0
10-23-58	51	6.9	132	35,000	240	10	0.42	0.90	1.3	9.8	3.8
11-20-58	42	7.6	148	54,000	320	9	0.06	1.7	2.3	8.6	1.5
3-19-59	35	8.1	594	22,000	940	80		1.7	3.2	7.6	15.
5-5-59	69	7.5	191	92,000	660	200	0.84	2.0	4.6	5.6	4.8
6-11-59	70	7.3	301	22,000	330	14	0.28	1.2	1.9	7.4	1.5
10-29-59	45	7.7		3,300	470	8	0.20	1.9	2.6	7.3	5.3

Upper Mississippi River Basin
Crow River

LOCATION: Dayton; Bridge on SH 101 STATION: Cr-0
RECORDS AVAILABLE: Water Quality Sampling Program, 1953-57, Minnesota Department of Health
REMARKS: Provisional flow data from gaging station at Rockford

CHEMICAL ANALYSIS IN MILLIGRAMS PER LITER, 1958-59

Date	Temp. (°F)	pH	Flow (cfs)	Coliform Group (MPN/100 ml)	Total Solids	Turbidity Value	Phosphorus (P)	Nitrates (N)	Total Nitrogen (N)	Dissolved Oxygen (DO)	Biochemical Oxygen Demand (5-Day BOD)
1-23-58	32	8.6	246	4,900	400	14				12.	5.0
4-1-58	45	8.4	582	200		12				12.	8.0
4-22-58	52	8.2	1,580	3,500	380	34				9.4	6.2
5-9-58	61	8.2	817	16,000		26				8.6	6.5
6-17-58	76	8.5	566	2,300	490	30	0.30		2.1	7.2	7.0
7-31-58	74	7.0	98	1,100		10				7.1	6.8
9-22-58	62	6.9	85	780		27				8.2	6.0
10-22-58	52	7.0	54	450	460	15	0.13	<0.1	0.20	7.0	5.0
4-28-59	50	7.8	100	450	420	12	0.28	0.04	1.8	9.5	6.0
6-8-59	76	7.9	169	490	420	21	0.36	<0.1	1.4	5.5	7.8
10-29-59	40	6.8		78	450	8	0.07	0.16	0.68	10.	3.0

Lower Mississippi River Basin
Gervais - Keller Lakes

LOCATION: Maplewood; Bridge on SH - 36 between the lakes
RECORDS AVAILABLE: None
REMARKS: Flow data not available

STATION: GK-1

CHEMICAL ANALYSIS IN MILLIGRAMS PER LITER, 1958-59

Date	Temp. (°F)	pH	Coliform Group (MPN/100 ml)	Total Solids	Turbidity Value	Phosphorus (P)	Nitrates (N)	Total Nitrogen (N)	Dissolved Oxygen (DO)	Biochemical Oxygen Demand (5-Day BOD)
6-22-58	66	7.4	400	370	68	0.24			7.2	17.
10-23-58	50		200	310	30	0.21	0.36	2.3	7.5	10.
12-4-58	32	6.4	78	390	5	0.35	1.0	2.0	14.	4.5
3-17-59	37	7.3	68	430	8	0.10	0.10	0.36	12.	3.0
4-28-59	52	7.2	170	450	10	0.60	0.04	2.2	14.	12.
7-21-59	83	8.6	230	440	50	0.33	4.1	7.1	12.	19.

Minnesota River Basin
Minnesota River

LOCATION: Courtland; Bridge directly south of Courtland STATION: Mi-129
RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, Minnesota Department of Health
REMARKS: Flow Data from gaging station at Mankato

CHEMICAL ANALYSIS IN MILLIGRAMS PER LITER, 1958-59

Date	Temp. (°F)	pH	Flow (cfs)	Coliform Group (MPN/100 ml)	Total Solids	Turbidity Value	Phosphorus (P)	Nitrates (N)	Total Nitrogen (N)	Dissolved Oxygen (DO)	Biochemical Oxygen Demand (5-Day BOD)
1-8-58	32	8.3	970	13,000	1,200	15				11.	2.8
2-17-58	32	8.3	450	13,000	980	7				8.2	2.2
4-16-58	57	8.2	6,960	9,500		48				8.2	5.0
6-3-58	66	7.3	2,050	35,000	700	80	0.38	0.10	1.7	6.8	4.0
6-25-58	67	8.2	1,940	13,000	860	40	0.20	<0.10		6.6	5.5
7-29-58	78	7.4	628	92,000		35				6.2	6.8
8-13-58	78	7.4	438	17,000		36				7.2	7.0
9-24-58	73	7.4	299	49,000		26				9.1	7.3
10-30-58	49	7.4		27,000	900	23	0.26		1.1	9.1	6.0
12-10-58	31	7.6		70,000	920	6	0.20	0.08	1.4	12.	4.6
2-17-59	31	6.5		130,000	1,070	9	0.52	0.40	2.4	0.5	2.5
5-19-59	68	7.4		17,000	840	32	0.47	0.16	1.6	8.0	8.3
6-18-59	74	8.1		70,000	760	25	0.34	0.14	1.4	4.9	8.8
11-19-59	34	8.0		49,000		18	0.19	0.92	2.0	12	4.8

Minnesota River Basin
Minnesota River

LOCATION: Henderson; Bridge on SH 19 **STATION: Mi-70**
RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, Minnesota Department of Health
REMARKS: Provisional data from gaging station at Carver

CHEMICAL ANALYSIS IN MILLIGRAMS PER LITER, 1958-59

Date	Temp. (°F)	pH	Flow (cfs)	Coliform Group (MPN/100 ml)	Totals Solids	Turbidity Value	Phosphorus (P)	Nitrates (N)	Total Nitrogen (N)	Dissolved Oxygen (DO)	Biochemical Oxygen Demand (5-Day BOD)
1-8-58	32	7.4	1,300	23,000	1,100	52				9.7	3.8
2-17-58	32	8.6	635	70,000	440	9				6.5	4.5
4-15-58	54	8.0	7,820	17,000		73				7.7	4.5
6-2-58	66	7.8	3,010	130,000	1,200	640	0.96	0.50	4.7	5.6	4.8
6-24-58	65	7.7	1,510	33,000	820	32	0.28	<0.1	1.6	7.0	5.5
7-28-58	76	6.7	592	21,000		26				7.5	6.9
8-11-58	82	7.6	765	2,000		40				6.3	7.0
9-23-58	66	7.6	368	350,000		17				6.4	10.
10-29-58	47	6.6	265	13,000	670	20	0.51		1.4	9.8	5.8
12-9-58	31	7.1	175	17,000	780	10	0.24	0.02	1.5	9.5	3.8
2-16-59	31	6.5		7,800	830	7	0.46	0.54	2.4	1.1	2.5
5-18-59	64	7.5		7,800	650	25	0.24	0.12	1.5	8.8	7.3
6-17-59	75	8.1		220,000	650	35	0.58	0.16	1.1	4.8	6.0
11-18-59	34	7.8		13,000	720	15	0.19	3.2	4.4	10.	3.0

Minnesota River Basin
Minnesota River

LOCATION: Ortonville; Above dam at outlet of Big Stone Lake
STATION: Mi-298
RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, Minnesota Department of Health
REMARKS: Flow data from gaging station at Ortonville

CHEMICAL ANALYSIS IN MILLIGRAMS PER LITER, 1958-59

Date	Temp. (°F)	pH	Flow (cfs)	Coliform Group (MPN/100 ml)	Total Solids	Turbidity Value	Phosphorus (P)	Nitrates (N)	Total Nitrogen (N)	Dissolved Oxygen (DO)	Biochemical Oxygen Demand (5-Day BOD)
5-19-58	62	8.2	257	450	810	36	0.18	<0.10	0.96	7.6	
7-8-58	62	8.2	34	350,000		27				3.9	6.9
8-4-58	77	6.7	7.8	9,200,000	830	15				NF	24.
9-9-58	70	6.8	4.7	920,000	650	4				NF	16.
10-14-58	59	6.8		140,000	570	10	0.70	0.20	2.1	NF	36.
11-14-58	37	8.4		17,000	210	15	0.56	0.20	1.5	11.0	1.5
1-6-59	32	7.0		170,000	1,670	25	3.6	<0.10	8.0	0.1	330.
10-19-59	50	7.6		7,800	920	28	1.5	0.06	2.3	NF	89.
11-30-59	33	7.6		49,000	1,100	20	1.4	<0.1	3.7		130

Minnesota River Basin
Minnesota River

LOCATION: St. Peter; Bridge on U.S. Highway 169 south of St. Peter STATION: Mi-97
RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, Minnesota Department of Health
REMARKS: Flow data from Mankato gaging station

CHEMICAL ANALYSIS IN MILLIGRAMS PER LITER, 1958-59

Date	Temp. (°F)	pH	Flow (cfs)	Coliform Group (MPN/100 ml)	Total Solids	Turbidity Value	Phosphorus (P)	Nitrates (N)	Total Nitrogen (N)	Dissolved Oxygen (DO)	Biochemical Oxygen Demand (5-Day BOD)
1-8-58	32	8.1	970	110,000	1,100	16				10.	3.5
2-17-58	32	8.5	450	130,000	890	11				7.2	4.8
4-15-58	54	7.9	7,210	7,800		60				6.9	5.8
6-2-58	66	7.6	2,090	160,000	860	400	0.72	0.70	3.8	6.0	4.0
6-24-58	65	7.9	1,200	92,000	850	50	0.28	0.10	1.7	6.7	5.3
7-28-58	77	6.6	622	130,000		39				8.4	7.3
8-11-58	82	7.4	526	54,000		30				8.3	7.2
9-23-58	71	7.6	239	33,000		24				8.0	7.3
10-29-58	59	6.8		220,000	720	15	0.39		1.1	9.8	7.0
12-9-58	32	7.2		350,000	820	6.0	0.21	0.16	1.8	9.6	4.3
2-16-59	34	6.7		49,000	900	10	0.60	0.46	2.5	3.5	3.5
5-18-59	62	7.9		14,000	710	23	0.23	0.20	1.6	8.1	6.5
6-17-59	74	8.4		540,000	710	35	0.37	0.24	1.2	5.9	5.8
11-18-59	34	7.7		49,000	710	18	0.20	3.6	4.7	12	2.8

Minnesota River Basin
Minnesota River

LOCATION: Shakopee; Bridge on CAR 18, 6 miles Northeast of Shakopee STATION: Mi-16.8
RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, Minnesota Department of Health
REMARKS: Provisional flow data from gaging station at Carver

CHEMICAL ANALYSIS IN MILLIGRAMS PER LITER, 1958-59

Date	Temp. (°F)	pH	Flow (cfs)	Coliform Group (MPN/100 ml)	Total Solids	Turbidity Value	Phosphorus (P)	Nitrates (N)	Total Nitrogen (N)	Dissolved Oxygen (DO)	Biochemical Oxygen Demand (5-Day BOD)
1-8-58	32	7.3	1,300	13,000	1,000	9				9.5	4.0
2-17-58	32	8.3	635	6,800	830	9				6.7	4.1
4-16-58	55	8.0	7,450	33,000		78				7.8	4.8
6-2-58	66	7.6	3,010	170,000	2,000	66	0.34	NF	1.6	6.0	5.3
6-24-58	65	7.5	1,510	170,000	750	30	0.26	<0.10	1.6	7.2	5.8
7-28-58	76	6.4	992	7,800		24				5.0	4.8
8-11-58	80	7.0	765	13,000	660	50				3.8	3.8
9-23-58	68	7.0	368	11,000	600	20				4.4	5.0
10-29-58	48	6.9	265	540,000	650	20	0.64		1.4	2.9	10.
12-9-58	31	7.5	175	7,800	850	16	0.22	<0.02	1.3	10.	6.1
2-16-59	31	6.4	199	9,300	800	8	0.43	1.4	3.0	0.9	3.0
5-18-59	62	7.6	846	2,300	600	33	0.30	0.12	1.4	6.8	6.3
6-18-59	73	8.0	1,510	170,000	710	35	0.31	0.28	1.1	4.8	4.5
11-18-59	34	7.2		240,000	650	14	0.17	3.1	4.4	10.	7.5

Upper Mississippi River Basin
Mississippi River

LOCATION: Anoka; Bridge on USH 169 STATION: UM-
RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, Minnesota Department of Health
REMARKS: Provisional flow data

CHEMICAL ANALYSIS IN MILLIGRAMS PER LITER, 1958-1959

Date	Temp. (°F)	pH	Flow (cfs)	Coliform Group (MPN/100 ml)	Total Solids	Turb Value	Phos (P)	Nitrates (N)	Total Nitrogen (N)	Dissolved Oxygen (DO)	Biochemical Oxygen Demand (5-Day BOD)
1-14-58	32	-	4,500		300	-					
1-22-58	32	8.6	4,400	2,300	260	8				9.6	4.8
1-28-58	32		4,800		240						
2-13-58	32		3,750		250						
3-31-58	46		5,700	1,700		10				13.	4.0
4-23-58	52	8.3	7,400	3,300		17				10.	6.5
5-9-58	60	8.3	5,020	2,300		13				8.4	5.0
5-15-58	67		4,630			7					2.6
5-21-58	68		4,170		270						
5-26-58	69	8.0	2,940		260						
6-5-58			3,970		180						
6-17-58	66	8.4	6,100	4,900	270	24	0.15		1.2	7.3	5.5
6-26-58	66		4,340		240						
7-10-58	70	7.0	6,290	24,000		19				7.3	4.4
7-17-58	70		4,950								
7-31-58	74		2,530		240						
8-6-58	82		3,600		240						

UPPER MISSISSIPPI RIVER BASIN
Mississippi River

LOCATION: Anoka; Bridge on USH 169 Station: UM-14
RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, Minnesota Department of Health
REMARKS: Provisional flow data

CHEMICAL ANALYSIS IN MILLIGRAMS PER LITER, 1958-1959

Date	Temp. (°F)	pH	Flow (cfs)	Coliform Group (MPN/100 ml)	Total Solids	Turb. Value	Phos (P)	Nitrates (N)	Total Nitrogen (N)	Dissolved Oxygen (DO)	Biochemical Oxygen Demand (5-Day BOD)
9-4-58	69	7.8	3,570	3,300	240	17				7.4	3.5
9-22-58	63		5,540		250						
10-7-58	60		2,720		180						
10-16-58	58		2,820		220						
10-22-58	52	7.2	2,960	2,300	220	2	0.04	0.28	1.0	7.0	2.3
11-5-58	45		2,800								
11-20-58	42	7.6	4,040	13,000	280	7	0.04	0.30	0.74	7.7	1.5
12-2-58	32	7.4	2,920	780	380	8	0.22	0.74	1.1	13.	3.1
1-8-59	31	7.1	2,130	4,600	340	7	0.04	2.0	2.6	6.3	1.3
2-26-59	33	7.8	1,700	7,900	280	7	0.11	1.2	1.9	7.0	2.5
3-12-59	34	7.7	2,140	230	340	5	0.09	<0.1	1.8	7.2	3.4
4-28-59	49	7.9	2,800	1,700	290	7	0.25	0.06	0.86	8.2	5.0
5-28-59	64		8,740	2,300	260	10	0.086	0.76	1.6	7.6	4.5
6- 8-59	73	7.7	16,500	4,900	300	20		.04	1.1	5.3	3.9
7-21-59	84		5,510	4,900	280	1	0.19	0.7	1.8	6.6	5.0
10-29-59	40	7.2		7,000	220	8	0.14	0.20	0.80	10.	3.3

Upper Mississippi River Basin
Mississippi River

LOCATION: Elk River; Bridge on SH 101 STATION: UM-26.7
RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, Minnesota Department of Health
REMARKS: Provisional flow data from gaging station near Anoka

CHEMICAL ANALYSIS IN MILLIGRAMS PER LITER, 1958-1959

Date	Temp. (°F)	pH	Flow (cfs)	Coliform Group (MPN/100 ml)	Total Solids	Turb Value	Phos (P)	Nitrates (N)	Total Nitrogen (N)	Dissolved Oxygen (DO)	Biochemical Oxygen Demand (5-Day BOD)
1-14-58	32		4,500		230						
1-22-58	32		4,400		210						
1-28-58	32		4,800		230						
2-13-58	32		3,750		250						
4-1-58	41	8.6	5,600	780		7				12.	4.8
4-22-58	51	8.3	7,430	3,300	200	17				11.	5.8
5-9-58	60	8.5	5,020	1,100		5				8.2	4.5
5-15-58	67		4,630			8					2.6
5-21-58	69		4,170		236						
5-26-58	70	7.8	2,940		260						
6-5-58			3,970		295						
6-17-58	66	8.4	6,100	4,900	240	16	0.11		1.2	11.	4.0
6-26-58	66		4,340		220						
7-10-58	70	7.0	6,290	17,000		18				7.7	4.6
7-17-58	70		4,950								
7-31-58	74		2,530		210						

Upper Mississippi River Basin
Mississippi River

LOCATION: Elk River; Bridge on SH 101 STATION: UM-26.7
RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, Minnesota Department of Health
REMARKS: Provisional flow data from gaging station near Anoka

CHEMICAL ANALYSIS IN MILLIGRAMS PER LITER, 1958-1959

Date	Temp (°F)	pH	Flow (cfs)	Coliform Group (MPN/100 ml)	Total Solids	Turb Value	Phos (P)	Nitrates (N)	Total Nitrogen (N)	Dissolved Oxygen (DO)	Biochemical Oxygen Demand (5-Day BOD)
8-6-58	81		3,600		220						
9-4-58	68	7.5	3,570	13,000	220	14				7.2	2.8
9-22-58	63		5,540		220						
10-7-58	60		2,720		200						
10-16-58	57		2,820		220						
10-22-58	52		2,960		220						
11-5-58	45		2,800								
11-20-58	40	7.7	4,040	2,300	260	5	0.04	0.10	0.54	9.5	1.3
12-2-58	32	7.0	2,920	7,900	330	7	0.48	1.2	1.7	12.	2.8
1-8-59	31	6.6	2,130	4,900	320	7	0.06	3.2	3.8	6.6	1.4
2-26-59	33	7.8	1,700	7,900	240	5	0.08	1.2	1.7	5.9	1.5
3-12-59	34	7.6	2,140	780	340	3	0.11	<0.1	.76	8.1	3.5
4-28-59	48	7.8	2,800	450	270	5	0.20	0.08	1.3	8.0	4.8
5-28-59	64		8,740	3,500	210	11	0.10	.72	1.4	7.9	3.5
6-18-59	72	7.6	16,500	11,000	250	18	1.5	<.1		5.0	3.9
7-12-59	82	7.7	5,510	160,000	300	17	0.19	0.7	1.9	7.1	7.5
10-29-59	40	7.9		13,000	200	8	0.16	0.20	0.62	11.	2.0

Lower Mississippi River Basin
Mississippi River

LOCATION: Hastings; Above lock and dam No. 2 **STATION:** LM-38
RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, Minnesota Department of Health
REMARKS: Flow data from gauging station at St. Paul

CHEMICAL ANALYSIS IN MILLIGRAMS PER LITER, 1958-1959

Date	Temp. (°F)	pH	Flow (cfs)	Coliform Group (MPN/100 ml)	Total Solids	Turb. Value	Phos (P)	Nitrates (N)	Total Nitrogen (N)	Dissolved Oxygen (DO)	Biochemical Oxygen Demand (5-Day BOD)
5-15-58	69	8.1	7,300	4,900	745	44	0.018	<.1	2.2	11	12
6-26-58	68	7.6	5,140	11,000	420	37	0.25	0.76	2.52	5.4	5.8
7-31-58	77	7.4	3,310	2,300	320					5.5	5.5
9-22-58	66	7.1	6,120	92,000	360	26				6.7	6.5
10-23-58	52	7.1		33,000	340	20	0.30	0.40	2.40	5.0	5.8
11-20-58	42	7.1		34,000	330	10	0.26	0.28	1.9	6.7	4.8
2-26-59	34	7.6		350,000	380	12	0.094	0.64	3.5	0.3	16
5-5-59	70	7.4		4,500	340	17	0.37	0.88	2.7	4.4	5.8
6-11-59	74	8.4		49,000	330	22	0.18	1.3	2.7	3.5	4.5
7-21-59	78	7.6		11,000	370	30	0.34	0.8	2.4	6.8	10
10-29-58	45	7.3		540,000	380	13	0.20	0.84	2.1	7.3	6.5

Lower Mississippi River Basin
Mississippi River

LOCATION: LaCrosse, Wisconsin; Bridge on USH 14 STATION: LM-108
RECORDS AVAILABLE: None
REMARKS: Flow data not yet available

CHEMICAL ANALYSIS IN MILLIGRAMS PER LITER, 1958-1959

Date	Temp. (°F)	pH	Flow (cfs)	Coliform Group (MPN/100 ml)	Total Solids	Turb. Value	Phos (P)	Nitrates (N)	Total Nitrogen (N)	Dissolved Oxygen (DO)	Biochemical Oxygen Demand (5-Day BOD)
5-13-58	61	8.4	15,600	780		14				10	5.8
6-19-58	69	7.8	19,300	2,300	270	20	0.28		1.4	7.0	4.5
7-21-58	74	7.6	23,200	1,300		50				6.2	
8-27-58	67	6.0	9,690	1,300		15				6.9	6.0
10-9-58	61	6.9		3,300	210	7	0.25	0.62	1.3	11	4.8
11-19-58	45	6.7		4,900	270	19	0.06	0.84	1.2	10	3.0
2-10-59	32	6.8		4,900	290	2	0.65	2.7	3.6	6.7	1.0
4-14-59	48	7.9		450		23	0.22	0.96	2.0		7.9
8-4-59	75	7.5		2,300	320	19	0.21	0.16	1.6	6.7	4.0

Upper Mississippi River Basin
Mississippi River

LOCATION: Sauk Rapids, Bridge on SH 152 at Sauk Rapids
STATION: UM-68
RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, Minnesota Department of Health
REMARKS: Flow data from gaging

CHEMICAL ANALYSIS IN MILLIGRAMS PER LITER, 1958-1959

Date	Temp (°F)	pH	Flow (cfs)	Coliform Group (MPN/100 ml)	Total Solids	Turb. Value	Phos (P)	Nitrates (N)	Total Nitrogen (N)	Dissolved Oxygen (DO)	Biochemical Oxygen Demand (5-Day BOD)
1-23-58	32	8.5	2,900		230	9				9.1	3.1
4-1-58	39	8.2	4,080	1,100		11				13	5.5
4-22-58	51	8.3	3,240	1,300	200	11				9.5	5.5
5-21-58	67	8.1	1,790	54,000		8	0.07		0.56	9.1	4.0
7-10-58	70	6.7	4,020	2,000		15				6.0	3.5
8-6-58	79	7.3	1,570	3,300		3				6.5	5.0
10-16-58	57	7.3		780	200	18	0.10	0.40	1.0	7.8	2.8
1-8-59	31	7.7		35,000	460	100	0.76	1.9	5.1	5.5	2.0
4-21-59	47	8.0		450	210	5	0.21	1.8	2.4	12	4.0
5-28-59	50			3,300	220	10	0.094	0.76	1.5	11	3.5
6-24-59	70	8.1		24,000	220	18	0.17	3.2	3.7	5.8	2.8
10-21-59	46	7.7		3,300	230	10	0.37	0.32	0.98	13	1.3

Upper Mississippi River Basin
O'Brien Brook

LOCATION: Pengilly; Bridge on CAR 171 east of Pengilly STATION: OB-5
REMARKS: Flow data not available

CHEMICAL ANALYSIS IN MILLIGRAMS PER LITER, 1958-59

Date	Temp. (°F)	pH	Coliform Group (MPN/100 ml)	Total Solids	Turbidity Value	Phosphorus (P)	Nitrates (N)	Total Nitrogen (N)	Dissolved Oxygen (DO)	Biochemical Oxygen Demand (5-Day BOD)
6-11-58	60	7.4	4,900	180	27	0.09		1.5	4.6	3.5
7-15-58	68	7.2	1,700		9			NF	6.2	3.5
9-30-58	52	7.0	200		3				8.7	0.3
11-6-58	40	6.7	78	280	4	0.01	NF	0.92	11.	NF
2-23-59	35	6.9	790	300	8	0.35	0.70	1.6		1.5
4-7-59	40	6.8	310	170	14	0.23	0.84	1.6	9.2	1.8
6-2-59	63	6.9	700	250	40	0.10	0.76	1.3	7.5	2.5
10-7-59		7.2	130	240	7	0.31	0.64		7.7	2.3

Lower Mississippi River Basin
Root River

LOCATION: La Crescent; Bridge on SH 26 STATION: Roo-2.5
RECORDS AVAILABLE: None
REMARKS: Flow data not yet available

CHEMICAL ANALYSIS IN MILLIGRAMS PER LITER, 1958-59

Date	Temp. (°F)	pH	Coliform Group (MPN/100 ml)	Total Solids	Turbidity Value	Phosphorus (P)	Nitrates (N)	Total Nitrogen (N)	Dissolved Oxygen (DO)	Biochemical Oxygen Demand (5-Day BOD)
5-13-58	65	8.0	1,700		30				9.1	7.8
6-19-58	68	7.7	7,000	260	37	0.38		1.7	7.7	4.5
7-21-58	75	7.6	1,700		64				10	4.5
8-27-58	62	6.3	22,000		15				8.7	3.5
10-9-58	60	6.5	3,300	300	7	0.22	0.46	0.70	8.0	2.0
11-19-58	42	6.9	35,000	420	30	0.21	1.5	1.8	8.5	2.3
2-10-59	31	6.9	7,900	330	5	0.46	3.0	3.3	7.8	0.5
4-14-59	45	7.8	1,300		23	0.21	1.9	3.0	8.3	2.5
8-4-59	69	8.1	160,000	2,100	480	3.9	0.85	6.9	5.7	9.3

Upper Mississippi River Basin
Rum River

STATION: Ru-34

LOCATION: Isanti; Bridge on CAR 5
RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, Minnesota Department of Health
REMARKS: Provisional flow data from gaging station near St. Francis

CHEMICAL ANALYSIS IN MILLIGRAMS PER LITER, 1958-59

Date	Temp. (°F)	pH	Flow (cfs)	Coliform Group (MPN/100 ml)	Total Solids	Turbidity Value	Phosphorus (P)	Nitrates (N)	Total Nitrogen (N)	Dissolved Oxygen (DO)	Biochemical Oxygen Demand (5-Day BOD)
1-22-58	32	8.0	210	22,000	240	11				6.7	3.3
4-2-58	45	8.1	378	7,900	200	6				11	4.2
4-23-58		7.9	632	1,700		17				9.6	6.3
5-15-58	68	8.3	388	13,000	280	20	0.01	<0.1	0.92	8.8	
6-17-58	66	8.5	354	17,000	260	20	0.19		1.3	7.7	6.0
7-17-58	70	7.6	327	24,000		14				8.1	6.9
9-4-58	67	7.6	171	160,000		23				9.4	6.3
10-22-58	50	5.6	191	92,000	270	5	0.16	0.20	1.1	6.1	3.3
12-4-58	32	6.8	140	17,000	240	6	0.08	1.3	1.9	9.3	3.5
3-17-59	34	7.8	155	54,000	250	5	0.22	0.46	1.0	7.6	3.6
4-28-59	50	8.2	172	2,300	240	11	0.30	0.06	1.3	9.0	7.5
6-3-59	70	7.1	714	3,300	250	50	0.16	0.44	1.4	5.2	3.8
10-29-59	40			11,000	270	8	0.08	0.26	0.66	9.5	2.3

Upper Mississippi River Basin
Rum River

LOCATION: Pease; Bridge on SAR 4; 3 miles east of Pease STATION: Ru-102
RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, Minnesota Department of Health
REMARKS: Flow data not available

CHEMICAL ANALYSIS IN MILLIGRAMS PER LITER, 1958-59

Date	Temp. (°F)	pH	Coliform Group (MPN/100 ml)	Total Solids	Turbidity Value	Phosphorus (P)	Nitrates (N)	Total Nitrogen (N)	Dissolved Oxygen (DO)	Biochemical Oxygen Demand (5-Day BOD)
1-22-58	32	8.0	780	280	12				0.1	4.0
4-2-58	39	8.0	35,000	160	7				12	6.0
4-23-58	48	7.3	7,900		15				11	2.9
5-15-58	68	8.5	1,700	230	8	0.01	<0.10	1.0	9.3	
6-10-58	65	7.2	7,900	190	8	0.15		2.6	6.4	3.0
7-14-58	70	8.3	3,300		9				4.7	
8-18-58	68	6.9	450		15				5.9	1.9
9-29-58	58	7.0	13,000		2				7.5	2.9
11-5-58	42	6.8	4,900	270	5	0.40	0.42	0.82	11	2.4
12-2-58	32	6.7	3,300	260	5	0.35	0.92	1.9	7.7	4.1
2-23-59	36	7.1	1,100			1.2	1.7	2.7	0.5	13
6-1-59	55	7.6	2,300	220	35	0.18	0.56	2.0	5.9	5.0
10-29-59	39		200	230	10	0.04	0.20	0.64	9.2	2.5

Upper Mississippi River Basin
Rum River

LOCATION: St. Francis; Bridge on SAR 8
RECORDS AVAILABLE: None
REMARKS: Provisional flow data

STATION: Ru-18

CHEMICAL ANALYSIS IN MILLIGRAMS PER LITER, 1958-59

Date	Temp. (°F)	pH	Flow (cfs)	Coliform Group (MPN/100 ml)	Total Solids	Turbidity Value	Phosphorus (P)	Nitrates (N)	Total Nitrogen (N)	Dissolved Oxygen (DO)	Biochemical Oxygen Demand (5-Day BOD)
5-7-58	60	8.2	528	23,000		10				9.8	4.1
6-17-58	66	8.6	354	3,300	240	20	0.30		1.6	8.8	7.2
7-17-58	71	7.2	327	6,400		16				8.3	6.4
9-4-58	67	7.7	171	1,300		18				8.8	5.8
10-22-58	50	6.7	191	7,900	260	5	0.31	0.24	0.88	6.0	2.8
12-4-58	32	6.6	140	7,900	280	5	0.26	1.0	1.6	8.5	3.5
3-17-59	34	7.9	155	200	220	5	0.01	0.50	0.88	8.3	3.0
4-28-59	50	8.0	172	20	260	13	0.19	0.04	1.2	11	6.8
6-8-59	75	7.5	714	5,400	230	18	0.22	<0.10	1.4	3.7	5.4

Upper Mississippi River Basin
Rum River

LOCATION: Vineland; Bridge on old U.S. Highway 169 at outlet of Mille Lacs Lake STATION: Ru-152
RECORDS AVAILABLE: None
REMARKS: Flow data not available

CHEMICAL ANALYSIS IN MILLIGRAMS PER LITER, 1958-59

Date	Temp. (°F)	pH	Coliform Group (MPN/100 ml)	Total Solids	Turbidity Value	Phosphorus (P)	Nitrates (N)	Total Nitrogen (N)	Dissolved Oxygen (DO)	Biochemical Oxygen Demand (5-Day BOD)
5-7-58	54	8.3	330		4				10	1.6
6-10-58	64	7.5	20	170	12	0.05		1.7	8.5	2.2
7-14-58	70	7.6	68		9				7.4	
8-18-58	69	7.5	78	200	25				6.4	3.6
9-29-58	59	7.0	790	120	2				9.1	2.3
11-5-58	42	6.7	330	160	5	0.30	0.28	0.68	9.6	1.2
12-2-58	32	7.0	490	330	4	0.12	0.30	1.1	9.2	3.5
2-23-59	34	6.8	780						0	80
6-1-59	60	7.9	45	150	3	0.05	0.16	0.7	7.7	2.5

St. Croix River Basin
St. Croix River

LOCATION: Danbury; Bridge on SH 48 west of Danbury STATION: SC-111
RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, Minnesota Department of Health
REMARKS: Flow data from gaging station at Danbury

CHEMICAL ANALYSIS IN MILLIGRAMS PER LITER, 1958-1959

Date	Temp (°F)	pH	Flow (cfs)	Coliform Group (MPN/100 ml)	Total Solids	Turb. Value	Phos (P)	Nitrates (N)	Total Nitrogen (N)	Dissolved Oxygen (DO)	Biochemical Oxygen Demand (5-Day BOD)
1-21-58	32	7.9	980	230	120					10	4.3
3-26-58	41	8.6	1,240	140	100					12	1.0
5-5-58	54	8.4	1,160	490	120	5	0.04	0.16	.64	9.4	2.3
6-12-58	62	7.6	1,030	130	120	11	0.01	0.60	.96	7.7	3.5
7-16-58	68	6.9	2,810	16,000		7				5.8	3.1
10-1-58	54	6.7		450	100	3				8.4	1.6
12-3-58	32	6.6				7	0.37	0.58	0.78	9.5	2.5
2-25-59	32	8.3		1,100	130	2	0.10	0.34	0.60	9.3	0.8
4-9-59	42	7.1		200	210	3	0.12	0.52	1.2	12	1.5
6-3-59	65	6.9		170	145	31	0.48	0.88	1.2	5.3	2.5
10-7-59		6.8		93	170	7	0.31	0.40	.90	7.2	3.0
11-16-59	33	7.9		230	100	5	0.19	0.30	.62	12	2.3
12-16-59	33	7.7		130	130	9	0.39	0.7	1.46	9.0	3.0

St. Croix River Basin
St. Croix River

LOCATION: Osceola, Bridge on SH 243 STATION: SC-45
RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, Minnesota Department of Health
REMARKS: Provisional flow data from gaging station at St. Croix Falls, Wisconsin

CHEMICAL ANALYSIS IN MILLIGRAMS PER LITER, 1958-1959

Date	Temp (°F)	pH	Flow (cfs)	Coliform Group (MPN/100 ml)	Total Solids	Turb. Value	Phos (P)	Nitrates (N)	Total Nitrogen (N)	Dissolved Oxygen (DO)	Biochemical Oxygen Demand (5-Day BOD)
6-17-58	68	7.8	3,570	1,300	180	10	.11		1.4	5.1	1.5
7-16-58	72	6.8	7,330			7				5.7	2.8
9-4-58	68	7.6	3,010	780		11				8.3	2.1
10-23-58	52	7.5	2,530	930	140	11	.052	.12	.40	8.0	1.8
12-3-58	32	7.3	2,640		200	8	.09	.60	1.2	9.4	4.8
2-25-59	36	8.2	1,550	1,300	170	2	.06	.44	.76	7.1	1.0
4-9-59	42	7.3	2,900	200	200	11	.10	.64	1.0	11.3	1.3
6-8-59	78	7.9	7,080	790	120	13	.09	<.1	.96	5.2	4.3
10-29-59	42	8.0		490	270	10	.29	.48	.78	7.3	4.3
12-16-59	33	7.3		1,300	140	9	.06	.7	.9	7.4	2.3

St. Croix River Basin
St. Croix River

LOCATION: Prescott; Bridge on USH 10 at Prescott, Wisconsin STATION: SC-0
RECORDS AVAILABLE: Water Quality Sampling Program, 195301957, Minnesota Department of Health
REMARKS: Provisional flow data from gaging station near St. Croix Falls, Wisconsin

CHEMICAL ANALYSIS IN MILLIGRAMS PER LITER, 1958-1959

Date	Temp (oF)	pH	Flow (cfs)	Coliform Group (MPN/100 ml)	Total Solids	Turb. Value	Phos (P)	Nitrates (N)	Total Nitrogen (N)	Dissolved Oxygen (DO)	Biochemical Oxygen Demand (5-Day BOD)
1-21-58	32	7.5	2,140	330	150					11	3.8
3-27-58	40	7.4	3,360	130	170		<0.01	0.12	.5	9.1	2.3
4-30-58	53	8.4	4,410	78		4				9.0	3.6
5-15-58	63	8.0	2,690	45	170	8	0.01	<0.10	.72	11	3.9
6-26-58	70	8.4	2,660	200	160	10	0.05	0.90	1.66	9.7	4.0
7-31-58	77	8.2	2,320	20	140	10				7.1	4.8
9-22-58	67	7.3	3,550	78	200	5				6.7	2.5
10-23-58	56	7.3	2,530	130	150	10	0.09	0.80	1.08	6.0	2.4
11-20-58	45	7.6	4,060	330	180	7	0.04	0.40	0.68	6.8	1.8
2-26-59	36	8.0	1,840	230	180	4	0.06	1.4	1.96	11	1.5
3-17-59	35	7.1	1,840	1,100	360	3	0.11	0.64	0.78	8.9	1.5
5-5-59	57	7.2	3,250	45	240	5	0.06	2.8	3.2	7.9	2.8
6-4-59	70	8.6	12,600	130	160	8	0.05	0.24	0.84	6.2	2.8
7-21-59	77	8.0	2,650	790	190	11	0.10			7.8	4.8
10-29-59	43	7.9		340	250	6	0.11	0.60	.98	7.9	3.8

St. Croix River Basin
St. Croix River

LOCATION: Stillwater; Bridge on SH 212 STATION: SC-22.6
RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, Minnesota Department of Health
REMARKS: Provisional flow data from gaging station near St. Croix Falls, Wisconsin

CHEMICAL ANALYSIS IN MILLIGRAMS PER LITER, 1958-1959

Date	Temp (°F)	pH	Flow (cfs)	Coliform Group (MPN/100 ml)	Total Solids	Turb. Value	Phos (P)	Nitrates (N)	Total Nitrogen (N)	Dissolved Oxygen (DO)	Biochemical Oxygen Demand (5-Day BOD)
3-27-58	38	8.0	3,360	450	130					12	3.0
6-17-58	70	8.3	3,570	450	170	14	0.20		1.3	6.9	4.0
7-16-58	70	7.1	7,330			9				6.1	2.8
9-4-58	70	8.0	3,010	450		18				7.5	4.0
10-23-58	52	7.5		1,300	150	10	0.10	0.24	0.48	6.6	2.3
12-4-58	32	8.0		200	120	7	0.12	1.5	2.3	9.6	2.8
2-26-59	35	8.0		1,400	170	5	0.11	1.5	2.0	9.9	1.5
4-28-59	52	8.0		130	150	10	0.24	0.08	0.68	9.8	4.3
6-11-59	75	7.4		1,700	180	13	0.30	3.6	4.6	5.1	3.8
10-29-59	43	8.1		2,300	230	10	0.17	0.48	0.78	8.1	4.3

Lower Mississippi River Basin
Straight River

LOCATION: Clinton Falls; Bridge on second undesignated road east and one mile south of Clinton Falls
RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, Minnesota Department of Health
REMARKS: Flow data not available STATION: St-18

CHEMICAL ANALYSIS IN MILLIGRAMS PER LITER, 1958-59

Date	Temp. (°F)	pH	Coliform Group (MPN/100 ml)	Total Solids	Turbidity Value	Phosphorus (P)	Nitrates (N)	Total Nitrogen (N)	Dissolved Oxygen (DO)	Biochemical Oxygen Demand (5-Day BOD)
1-29-58	32	8.2	79.000	480	15				11	2.9
4-8-58	45	8.0	23,000	450	15				10	5.0
4-30-58	47	8.2	7,800		6				12	3.8
5-12-58	70	8.3	2,000		16				13	5.8
6-18-58	70	7.3	13,000	560	15	0.62		2.7	8.7	2.2
7-22-58	74	7.8	2,300		50				15	5.8
8-26-58	60	6.6	35,000		8				5.1	6.8
10-8-58	60	6.7	1,600,000	330	32	0.20	0.92	1.6	1.9	15
11-18-58	40	6.7	22,000	490	19	0.70	1.2	1.6	7.2	6.3
2-9-59	33	6.8	13,000	740	5	2.8	1.9	8.0	4.0	2.8
3-17-59	36	7.4	49,000	500	15		0.84	3.2	7.3	7.8
4-13-59	46	7.8	12,000	480	12	0.32	2.1	3.5	10	3.0
8-3-59	78	8.6	2,000	530	10	0.86	1.3	3.0	16	6.5
11-3-59	44	7.7	4,900	490	8	0.31	3.0	4.4	10	5.3

Lower Mississippi River Basin
North Middle Branch of the Zumbro River

LOCATION: Oronoco; 3/4 mile northwest on U.S. Highway 52 to first road west, 3/4 mile west to first road south, and south to bridge
RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, Minnesota Department of Health
REMARKS: Flow data not available

STATION: NMBZ-9

CHEMICAL ANALYSIS IN MILLIGRAMS PER LITER, 1958-59

Date	Temp. (°F)	pH	Coliform Group (MPN/100 ml)	Total Solids	Turbidity Value	Phosphorus (P)	Nitrates (N)	Total Nitrogen (N)	Dissolved Oxygen (DO)	Biochemical Oxygen Demand (5-Day BOD)
1-30-58	32	8.3	79,000	300	10				12	2.8
4-7-58			33,000		130				10	7.8
4-29-58	46	8.0	2,000		10				10	5.8
6-19-58	70	7.5	13,000	460	23	0.22		1.4	8.1	3.5
7-21-58	68	7.6	3,300		40				7.2	3.5
8-27-58	68	6.1	4,600		8				9.6	4.3
10-9-58	61	6.5	35,000	360	7	0.24	1.3	2.1	9.5	7.8
11-19-58	42	7.4	13,000	330	14	0.16	1.8	2.0	10	0.5
2-11-59	31	6.5	200	500	2	0.60	3.6	4.4	6.2	0.5
4-14-59	52	7.4	3,300	320	17	0.28	1.5	1.9	9.5	2.8
8-4-59	83	7.5	11,000	430	23	0.37	0.92	1.8	10	3.5
11-4-59	40	7.8	17,000	410	15	0.10	2.0	2.7	8.5	5.8

Lower Mississippi River Basin
South Branch of the Zumbro River

LOCATION: Rochester; North on U.S. Highway 63 to SAR 14, west on SAR 14 ½ mile to first road north, north 2 miles and west to bridge

RECORDS AVAILABLE: Water Quality Sampling Profram, 1953-1957, Minnesota Department of Health

REMARKS: Flow data from gaging station at Rochester

STATION: SBZ-17

CHEMICAL ANALYSIS IN MILLIGRAMS PER LITER, 1958-59

Date	Temp. (°F)	pH	Flow (cfs)	Coliform Group (MPN/100 ml)	Total Solids	Turbidity Value	Phosphorus (P)	Nitrates (N)	Total Nitrogen (N)	Dissolved Oxygen (DO)	Biochemical Oxygen Demand (5-Day BOD)
1-30-58	34	8.4	38	130,000	350	16				8.9	3.9
4-7-58			133	95,000		40				10	8.8
4-29-58	45	7.7	70	49,000		7				8.0	5.3
6-19-58	70	7.4	88	17,000	350	25	1.1		3.4	7.2	5.8
7-21-58	70	7.6	33	23,000		80				5.9	3.5
8-27-58	68	6.0	26	33,000		8				7.7	6.8
10-9-58	58	6.8		33,000	390	10	0.37	1.5	3.7	6.7	5.3
11-19-58	44	7.6		540,000	590	15	0.96	1.7	3.0	6.7	4.5
2-11-59	33	6.6		130,000	640	5	2.4	1.4	4.7	4.6	5.3
4-14-59	58	7.2		110,000	350	17	0.06	1.8	2.9	7.9	3.7
8-4-59	82	8.0		170,000	520	50	0.72	1.7	3.0	5.2	3.8
11-4-59	43	7.6		540,000	430	20	0.43	2.0	3.4	6.6	7.5

Lower Mississippi River Basin
North Branch of the Zumbro River

LOCATION: Zumbrota; Bridge on SAR 10, 1½ miles east of Zumbrota
STATION: NBZ-72
RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, Minnesota Department of Health
REMARKS: Flow data not available

CHEMICAL ANALYSIS IN MILLIGRAMS PER LITER, 1958-59

Date	Temp. (°F)	pH	Coliform Group (MPN/100 ml)	Total Solids	Turbidity Value	Phosphorus (P)	Nitrates (N)	Total Nitrogen (N)	Dissolved Oxygen (DO)	Biochemical Oxygen Demand (5-Day BOD)
1-30-58	32	8.3	130,000	390	14				11	2.5
4-7-58			79,000		75				10	7.3
4-29-58	46	8.2	79,000		8				11	8.3
6-19-58	69	7.5	240,000	540	17	0.44		2.7	5.3	11
7-21-58	69	7.2	4,500		38				3.5	3.8
8-27-58	62	6.3	35,000		8				6.0	5.3
10-9-58	57	7.2	240,000	380	10	0.36	0.78	2.0	5.8	4.5
11-19-58	36	7.6	350,000	420	10	0.19	1.1	1.4	9.1	2.3
2-11-59	32	6.9	240,000	540	2	1.2	3.2	4.5	3.5	5.0
4-14-59	52	7.4	130,000	360	15	0.04	1.4	2.9	10	7.3
8-4-59	75	7.7	240,000	460	20	0.34	2.0	3.7	6.5	6.8
11-4-59	42	8.0	17,000	540	15	0.11	1.7	2.3	7.6	5.5

WATER QUALITY SAMPLING PROGRAM
1958 and 1959

RADIOACTIVITY DATA

Station and Date	Total Gross Beta	Dissolved Gross Alpha	Dissolved Gross Beta	Suspended Gross Alpha	Suspended Gross Beta
		Big Cottonwood River			
Be-5.3, New Ulm*					
Jan. 8, 1958	8.4				
Feb. 17, 1958	8.7				
April 16, 1958		39	27		
		Blue Earth River			
Be-63, Winnebago*					
Jan. 9, 1958	38				
Jan. 29, 1958	IFB**				
April 15, 1958			35		IFB
Be-84, Blue Earth*					
Jan. 9, 1958	4.8				
Jan. 29, 1958	IFB				
April 15, 1958			17		IFB
		Cannon River			
Ca-13.4, Welch*					
Jan. 30, 1958	12				
April 29, 1958			25		IFB
Ca-37.6, Northfield*					
Jan. 29, 1958	31				
April 30, 1958			34		IFB

* Specific station location details given in preceding section

** IFB - Indistinguishable from background

WATER QUALITY SAMPLING PROGRAM
1958 and 1959

RADIOACTIVITY DATA

Station and Date	Total Gross Beta	Dissolved Gross Alpha	Dissolved Gross Beta	Suspended Gross Alpha	Suspended Gross Beta
Minnesota River					
Mi-16.8, Shakopee*					
Jan. 8, 1958	23				
Feb. 17, 1958	81				
April 15, 1958			60		13
June 2, 1958		1.5	45	2.3	24
June 24, 1958		9.0	22	IFB**	IFB
July 28, 1958		4.8	89	0.35	47
Aug. 11, 1958		8.1	77	0.73	35
Sept. 23, 1958		10	40	2.0	IFB
Oct. 29, 1958		0.9	48	1.4	25
Dec. 9, 1958			8.0		17
Feb. 16, 1959		1.4	13	0.53	IFB
May 18, 1959		2.0	60	1.6	IFB
June 18, 1959			57		IFB
Mi-70, Henderson*					
Jan. 8, 1958	32				
Feb. 17, 1958	63				
April 15, 1958			58		13
June 2, 1958		IFB	19	6.6	91
Mi-97, St. Peter*					
Jan. 8, 1958	25				
Feb. 17, 1958	51				
April 15, 1958			79		7.0
June 2, 1958		1.3	42	0.85	48
Mi-129, Courtland*					
Jan. 8, 1958	11				
Feb 17, 1958	44				
April 16, 1958			59		IFB
June 2, 1958		0.68	51	0.9	57
Nov. 19, 1959		2.8	15	0.4	10
Mi-298, Ortonville*					
May 19, 1958		6.6	64	2.3	52
July 8, 1958		12	18	5.3	26
Aug. 4, 1958		8.5	42	0.81	IFB
Sept. 9, 1958		2.9	48	1.3	17
Oct. 14, 1958		5.5	12	IFB	64
Nov. 14, 1958			48		32
Jan. 6, 1959		8.5	14	3.3	IFB

* Specific station location details given in preceding section

** IFB - Indistinguishable from background

WATER QUALITY SAMPLING PROGRAM
1958 and 1959

RADIOACTIVITY DATA

Station and Date	Total Gross	Dissolved Gross		Suspended Gross	
	Beta	Alpha	Beta	Alpha	Beta
Mississippi River					
LM-38, Hastings*					
May 15, 1958		9	20	1.5	10
June 26, 1958		3.5	53	1.1	IFB**
July 31, 1958		3.8	62	2.0	11
Sept. 22, 1958		1.9	40	IFB	16
Oct. 23, 1958		0.8	63	1.6	31
Nov. 20, 1958			64		IFB
Feb. 26, 1959		3.3	8.3	1.3	9
Mar. 17, 1959		IFB	6.0	0.25	IFB
June 11, 1959			29		24
July 21, 1959			18		13
LM-108, La Crosse Wisc.*					
May 13, 1958		2.6	IFB	1.1	IFB
June 19, 1958		1.6	37	2.2	16
July 21, 1958		1.5	54	0.96	19
Aug. 27, 1958		0.44	50	IFB	8.7
Oct. 9, 1958		IFB	38	0.75	120
Nov. 19, 1958			64		11
Feb. 10, 1959		1.4	12	0.36	5.5
April 14, 1959		IFB	25	0.86	20
Aug. 4, 1959			44		28

* Specific station location details given in preceding section

** IFB - Indistinguishable from background

WATER QUALITY SAMPLING PROGRAM
1958 and 1959

RADIOACTIVITY DATA

Station and Date	Total Gross Beta	Dissolved Gross Alpha	Dissolved Gross Beta	Suspended Gross Alpha	Suspended Gross Beta
Mississippi River					
UM-14, Anoka*					
Jan. 14, 1958	27				
Jan. 22, 1958	IFB**				
Jan. 28, 1958	IFB				
Feb. 13, 1958	IFB				
March 31, 1958	11				
April 23, 1958			19		IFB
May 9, 1958		3.6	21	0.26	IFB
May 15, 1958			23		7.5
May 21, 1958		IFB	IFB	2.2	7.0
May 26, 1958		1.1	19	0.32	39
June 5, 1958		0.4	30	0.78	47
June 17, 1958		1.6	39	IFB	37
June 26, 1958		2.2	29	4.0	8.2
July 10, 1958		1.8	92	IFB	43
July 17, 1958		12	240	IFB	15
July 31, 1958		IFB	42	3.2	18
Aug. 6, 1958		3.6	81	0.46	28
Sept. 4, 1958		0.84	52	IFB	7.5
Sept. 22, 1958		IFB	44	0.82	28
Oct. 7, 1958		IFB	7.4	0.47	IFB
Oct. 16, 1958		3.1	64	2.9	18
Oct. 22, 1958		2.7	27	2.1	IFB
Nov. 5, 1958		3.9	110	1.1	70
Nov. 20, 1958			92		17
Dec. 2, 1958			40		IFB
Jan. 8, 1959		IFB	70	0.78	11
Feb. 26, 1959		0.61	13	0.4	20
March 12, 1959		1.6	23	0.18	9.9
April 28, 1959		2.0	19	0.44	IFB
May 28, 1959			25		48
June 8, 1959			31		34
July 21, 1959			28		4.0
Oct. 29, 1959		0.42	9.3	0.43	IFB

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* Specific station location details given in preceding section

** IFB - Indistinguishable from background

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WATER QUALITY SAMPLING PROGRAM
1958 and 1959

RADIOACTIVITY DATA

Mississippi River

Station and Date	Total Gross	Dissolved Gross		Suspended Gross	
	Beta	Alpha	Beta	Alpha	Beta
UM-26.7, Elk River*					
Jan. 14, 1958	31				
Jan 22, 1958	IFB**				
Jan. 28, 1958	18				
Feb. 13, 1958	23				
April 1, 1958	28				
April 22, 1958		1.8	17		
May 9, 1958		0.75	20	0.72	18
May 15, 1958			33		IFB
May 21, 1958		IFB	28	3.9	18
May 26, 1958		IFB	38	IFB	19
June 5, 1958		1.5	28	1.7	22
June 17, 1958		1.6	49	IFB	29
June 26, 1958		1.4	29	IFB	IFB
July 10, 1958		2.5	94	0.97	31
July 17, 1958		12	90	IFB	44
July 31, 1958		18	72	1.2	27
August 6, 1958		1.7	100	IFB	29
Sept. 4, 1958		IFB	47	0.33	33
Sept. 22, 1958		2.6	61	1.8	24
Oct. 7, 1958		IFB	24	0.78	IFB
Oct. 16, 1958		1.3	37	1.3	11
Oct. 22, 1958		2.5	25	4.8	7.7
Nov. 5, 1958		IFB	140	1.7	68
Nov. 20, 1958			69		IFB
Dec. 2, 1958			47	0.33	31
Jan. 8, 1959		IFB	34	IFB	IFB
Feb. 26, 1959		2.2	IFB	0.27	12
March 12, 1959		0.92	32	IFB	IFB
April 28, 1959		1.6	21	0.43	42
May 28, 1959			54		25
June 8, 1959			36		17
July 21, 1959			8.4		11
Oct. 29, 1959		0.95	10	IFB	7.2
UM-68, Sauk Rapids*					
Jan. 23, 1958	31				
April 1, 1958	25				
April 22, 1958		3.1	14	IFB	17

* Specific station location details given in preceding section
** IFB - Indistinguishable from background

WATER QUALITY SAMPLING PROGRAM
1958 and 1959

RADIOACTIVITY DATA

Station and Date	Total Gross Beta	Dissolved Gross Alpha	Dissolved Gross Beta	Suspended Gross Alpha	Suspended Gross Beta
Root River					
Roo-2.5, La Crescent*					
June 19, 1958		IFB**	14	IFB	21
July 21, 1958		8.2	46	1.8	20
Aug. 27, 1958		IFB	23	IFB	12
Oct. 9, 1958		1.6	33	1.3	19
Nov. 9, 1958			28		IFB
Feb. 10, 1959		1.3	19	1.1	20
April 14, 1959		1.1	11	0.78	IFB
Aug. 4, 1959			150		97
Rum River					
Ru-34, Isanti*					
Jan. 22, 1958	12				
April 2, 1958	17				
April 23, 1958		3.1	23	2.8	28
Ru-102, Pease*					
Jan. 22, 1958	23				
April 2, 1958	61				
April 23, 1958			29		17
June 10, 1958		0.95	50	0.88	23
Ru-152, Vineland*					
May 7, 1958		0.4	9.2	IFB	IFB
June 10, 1958		IFB	23	1.3	20
July 14, 1958		14	75	IFB	59
Aug. 18, 1958		0.4	41	0.32	44
Sept. 29, 1958			80	2.8	IFB
Nov. 5, 1958		3.6	190	1.1	96
Dec. 2, 1958			100	IFB	21
June 1, 1959			37		13

* Specific station location details given in preceding section
** IFB - Indistinguishable from background

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WATER QUALITY SAMPLING PROGRAM
1958 and 1959

RADIOACTIVITY DATA

Station and Date	Total Gross	Dissolved Gross		Suspended Gross	
	Beta	Alpha	Beta	Alpha	Beta
		St. Croix River			
SC-0, Prescott Wisc.*					
Jan. 21, 1958	22				
March 27, 1958	30				
April 30, 1958		0.38	IFB**	IFB	IFB
May 15, 1958			7.7		32
June 26, 1958		IFB	52	IFB	8.6
July 31, 1958		1.2	54	1.1	IFB
Sept. 22, 1958		IFB	16	0.34	IFB
Oct. 23, 1958		IFB	29	2.1	18
Nov. 20, 1958			33		IFB
Feb. 26, 1959		1.6	23	0.47	19
March 17, 1959		0.8	12	0.24	IFB
May 5, 1959		0.4	17	0.30	23
June 11, 1959			19		IFB
July 21, 1959			16		6.0
SC-22.6, Stillwater*					
March 27, 1958	35				
SC-45, Osceola*					
April 9, 1959		0.36	2.1	IFB	IFB
SC-111, Danbury*					
Jan.21, 1958	8.7				
March 26, 1958	23				
May 5, 1958		0.93	11	0.63	16
June 12, 1958		IFB	28	IFB	IFB
July 16, 1958		6.3	85	IFB	25
Oct. 1, 1958		2.0	17	1.1	9.7
Dec. 3, 1958			7.0	0.65	23
Feb. 25, 1959		IFB	23	0.46	18
April 9, 1959		1.4	10	0.19	14
June 3, 1959			23		IFB

* Specific station location details given in preceding section

** IFB - Indistinguishable from background